SATELLITE-TRACKED SURFACE DRIFTER PROGRAM: SCOTIAN SHELF 2007 AND THE GULF OF ST. LAWRENCE 2008-2009

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by

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Abstract

van der Baaren, A. and C. L. Tang. 2009. Satellite-tracked Surface Drifter Program: Scotian Shelf 2007 and The Gulf of St. Lawrence 2008-2009. Can. Data Rep. Hydrogr. Ocean Sci. 183: ix + 80 p.

Satellite-tracked surface drifters manufactured by MetOcean Data Systems Limited and Seimac Limited were deployed in the fall of 2007 and 2008 to collect surface current data. A total of 13 drifters were released from ships on the Scotian Shelf in 2007, and 23 in the Gulf of St. Lawrence in 2008. The data (position and sea surface temperature) were transmitted via the ARGOS system. The methods of data processing, error editing and calculation of surface velocities are described. It was found that the ARGOS data contained significant gaps including some greater than 12 hours. Many of the data gaps occurred near the changeover of the months or around midnight for specific days. Deployment sites, surface trajectories, time series of position, surface velocities, and sea surface temperature are displayed in graphic forms. Basic statistics of positions, velocities and sea surface temperature were compiled and tabulated. In 2007, the drifters tended to drift southeastward across the shelf for those that were tracked longer than 5 days. The 2007 Seimac drifters were only deployed for 5 days and all but one followed a southerly course during that time. The 2008 drifters in the Gulf of St. Lawrence, for the most part, traveled southeasterly to exit the Gulf of St. Lawrence via Cabot Strait.

Résumé

van der Baaren, A. and C. L. Tang. 2009. Satellite-tracked Surface Drifter Program: Scotian Shelf 2007 and The Gulf of St. Lawrence 2008-2009. Can. Data Rep. Hydrogr. Ocean Sci. 183: ix + 80 p.

Des dériveurs de surface suivis par satellite, fabriqués par MetOcean Data Systems Limited et Seimac Limited, ont été déployés à l'automne 2007 et 2008 afin de recueillir des données sur les courants de surface. En 2008, des navires ont largué au total 13 dériveurs au-dessus de la plate-forme Néo-Écossaise et 23 dériveurs dans le golfe du Saint-Laurent. Les données (position et température de surface de la mer) ont été transmises au moyen du système ARGOS. Nous décrivons les méthodes utilisées pour le traitement des données, le traitement des erreurs et le calcul des vitesses superficielles. Nous avons constaté que les données ARGOS présentent d'importantes lacunes et que, dans certains cas, des données sont manquantes pour des périodes supérieures à 12 heures. Plusieurs de ces lacunes surviennent lors du changement d'un mois à un autre ou près de minuit selon des jours particuliers. Les lieux de déploiement, les trajectoires en surface, les séries chronologiques des positions, les vitesses superficielles et la température de surface de la mer sont représentés sous forme de graphiques. Les statistiques de base sur les positions, les vitesses et la température de surface de la mer ont été compilées et présentées sous forme de tableaux. En 2007, les dériveurs tendaient à

se déplacer vers le sud-est au-dessus de la plate-forme Néo-Écossaise, notamment ceux qui ont été suivis pendant plus de cinq jours. En 2007, le déploiement des dériveurs Seimac n'a duré que cinq jours et tous ces dériveurs, sauf un, ont suivi une trajectoire vers le sud pendant cette période. Les dériveurs déployés en 2008 dans le golfe du Saint-Laurent se sont déplacés vers le sud-est, pour la plupart, pour ensuite sortir du golfe par le détroit de Cabot.

1 Introduction

As part of a surface current study, satellite-tracked surface drifters were deployed in eastern Canadian waters to collect surface current data. The purpose of the study is to use drifter data to calibrate and validate surface trajectories calculated from an ocean forecast model, Canadian East Coast Ocean Model, CECOM (Tang et al., 2007, 2008). The model data have been made available to users including Canadian Coast Guard for use in CANSARP (Canadian Search and Recur Planning), which is a planning tool for search and rescue operations.

Two validation trials were conducted. The first was conducted in October 2007 over the Scotian Shelf. Thirteen surface drifters were deployed at 7 sites along two lines offshore of Halifax during the fall cruise for the Atlantic Zone Monitoring Program (AZMP) aboard *CSS Hudson* (Figure 1). At each site, one or more drifters were released within a radius of 1 km. An Acoustic Doppler Current Profiler (ADCP) was moored at CS1, CS2 and CS3 at the time of the drifter release, and recovered six months later. The ADCPs collected current data in the water column which were used in model validation. The second field trial took place in October 2008 in the Gulf of St. Lawrence. Twenty-three surface drifters were deployed in 4 clusters from Canadian Coast Guard ships. Figure 2 shows the locations of the clusters indicated by "P', "Q", "C", and "S".

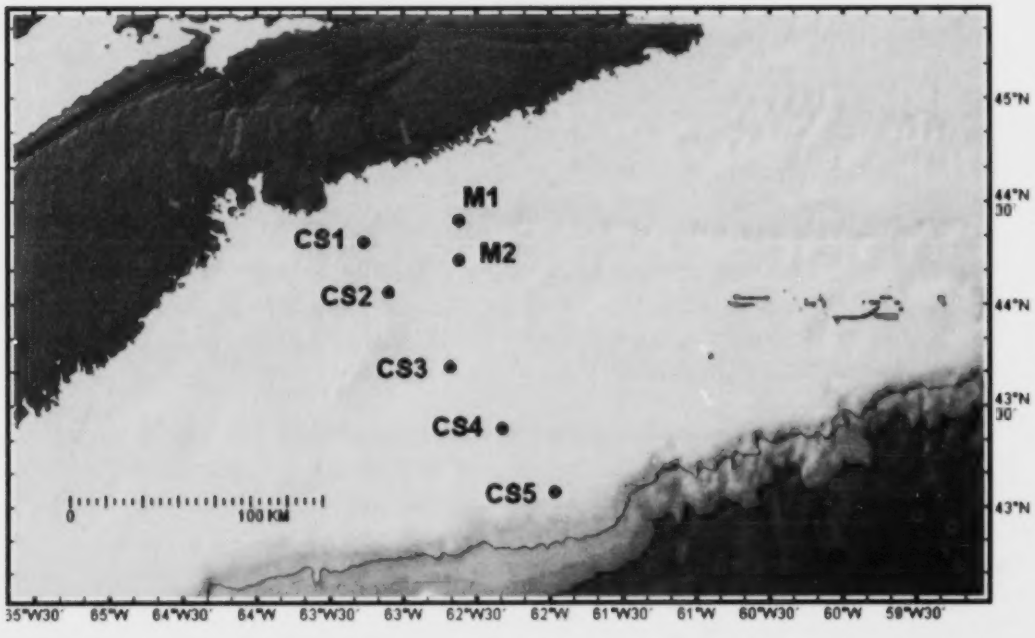

Figure 1 Drifter deployment sites for 2007

Figure 2 Drifter deployment sites for 2008

2 Procedure

Two types of surface drifters were used in the study: Self-Locating Datum Marker Buoy (SLDMB) manufactured by MetOcean Data Systems Limited, and Self-Locating Datum Marker Buoy (SLDMB) manufactured by Seimac Limited, both at Dartmouth, Nova Scotian. For the Seimac drifters, the Person-in-Water emulation mode was selected at the time of deployment. The data were transmitted via satellite for a maximum of one week. The MetOcean drifters had no set time limit for data transmission. They continued to transmit data until the battery ran out of power.

The drifters are equipped with Global Positioning System (GPS) receivers which give higher resolution positioning than can be provided by drifters who obtain positions from System ARGOS alone. System ARGOS (http: www.argos-system.org) satellites receive data transmissions when they pass overhead.

Data translation and error editing of data from the MetOcean drifters are described in the following sub-sections. Data from the Seimac drifters were processed by Canadian Coast Guard, which needed no translation or editing and were used directly upon receiving the files.

Figure 2 Drifter deployment sites for 2008

2 Procedure

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2.1 MetOcean drifters

The MetOcean drifter has a cylindrical hull for the electronics, four vanes each measuring 50 cm by 70 cm with a foam float attached to it and an antenna above the hull. The drifters provide position data and sea surface air temperatures every half-hour. Similar drifters have been used to track ice drift (van der Baaren and Prinsenberg 2000a,b, 2001, 2006); the only difference being that the ice drifters provided hourly data.

Data were gathered every half hour and data messages were transmitted every 90 s. With these drifters, 3 hours of data are transmitted. Data messages are updated internally every time the drifter obtains new location fixes. When a System ARGOS satellite passes overhead several transmissions of the same data can be sent. This continues until the drifter "dies" (i.e. the battery dies, it sinks, is picked up by a passing fisherman, etc.).

Data transmissions include latitude, longitude, GPS time, GPS satellite constellation identification, data quality filters, and sea surface temperature. System ARGOS data that are downloaded contain not only the GPS information but also position information gathered by the ARGOS satellites. This ARGOS data are found in each transmission "header" line. The difference between the Position and SST and the ARGOS data is found in the frequency and accuracy: the Position and SST are more frequent and more accurate. The MetOcean manual states that the resolution is good to approximately 20 m within a ±91 km range (MetOcean, 2004).

The MetOcean drifters deployed on the Scotian Shelf in 2007 remained afloat until mid-December in the case of 2 drifters but the others were active from the time of deployment to mid and late November.

2.2 Seimac position drifters

The Canadian Coast Guard released 6 Seimac position-only drifters on the Scotian Shelf in 2007 and 14 in the Gulf of St. Lawrence in 2008. The drifter has a pyramid shaped float above the water line, an electronic unit underneath and a fishnet-type surface drogue tethered to the electronic unit. These drifters were active for 1 week and provided hourly position information only as gathered by ARGOS satellites. The data for these drifters are also presented in this report although they did not undergo the same preliminary translation and editing as the GPS drifters. The data were processed by the Canadian Coast Guard.

2.3 Data translation of MetOcean drifters

Data were "translated" from the ARGOS data files archived by the Bedford Institute of Oceanography. Data arrived in monthly files sent by System ARGOS. The data were from October to December 2007 and from October 2008 to January 2009. From these files, three data files were created for each drifter: a data file that contained the GPS time series half-hourly data; a "header" file that contained ARGOS header position data; and a "dump" file that contained all data from all transmissions. The dump file acts as a direct data dump to check for transmission errors and translation errors.

The desired, final time interval of positions is half-hourly for the Position and SST. Due to the repetition of data transmissions (called "repeats"), as well as the drifter's ability to store 3 hours of data, redundancy of data is very present. This redundancy can easily be seen by a single glance at just one dump file. Redundancy was handled through quality control filtering. Transmissions for a single half-hour during which no satellites were counted to obtain fixes were ignored because such transmissions give bad data. Data with values outside the range of possibilities for data listed in the MetOcean user manual were also ignored. All acceptable data for that half-hour time slot were given a single value by using the median value of those remaining data.

2.4 Error editing

Data were edited "manually". Position errors were easily spotted by plotting GPS latitudes and GPS longitudes for each drifter as time series and superimposing the ARGOS pass latitudes and longitudes from the headers of the ARGOS messages. Errors were also spotted by looking at discrete jumps in latitude or longitude within a short series of points. If the drifter appeared to move an "unreasonable distance" in a short time period then the data were examined for a lack of flow. Bad data were flagged and then deleted and interpolation was used to fill all the small data gaps as needed. Larger data gaps in the Position and SST (generally > 12 hours but sometimes as small as 6 hours) and gaps for which header data showed had a "non-linear" trend were filled with positions from the ARGOS message header. These header data were first smoothed with a moving average filter (5 point window) and then interpolated to half-hourly. Data gaps were most common in the 2008-2009 Gulf of St. Lawrence Position and SST and common just before midnight every day.

Because each drifter's monthly data were translated separately there existed overlap at midnight of the last day of the month and early on the first day of the next month. This overlap is a repetition of one or two data transmissions but usually with fewer repeats. The repeated data found at the beginning of each month were deleted since including them and recalculating the median for those times did not make a significant difference.

Finally, data were linearly interpolated to fill smaller data gaps to give complete half-hourly time series of positions and measured surface temperatures.

2.5 Drifter drift

To compute the drift velocities for the drifters two methods were used. One method computed a point-to-point difference and divided by the time interval between the two points to give an average velocity: $\mathbf{U} = \Delta x/\Delta t$ where Δx is the distance between 2 longitudinal or latitudinal positions and Δt is the time interval (between every 6^{th} position gives a 3 hour interval for Position and SST).

The other method computed an instantaneous velocity by finding the slope of the tangent to the curves traced by longitude and latitude data. In this case a moving window of N points was used such that a second degree polynomial was fit to the curve depicted

by these windowed data points. The first derivative of this polynomial provided the tangent line and the slope of this line gave the velocity at the mid-point of the window. The windows were moved by the number of points that would give the desired final time interval. For example, for the Position and SST the window would move by 6 points to give a final 3-hourly sampling interval. This method of computing drift velocities has the added advantage of smoothing data. Several window sizes were tried starting with an 8-hour window and decreased to the final accepted 3-hour window. The problem was that the larger windows tended to underestimate the drift speeds (especially prevalent for v – north-south component) when the instantaneous velocity components were compared to the average velocity components computed from point-to-point differencing.

3 2007 Scotian Shelf Drifters

The deployment information for the Scotian Shelf drifters (both MetOcean and Seimac drifters) is listed in Table 1 and the deployment sites are shown in Figure 3. Basic statistics for the 2007 deployment are given in Table 2.

Drift tracks for the 2007 drifters are shown in Figure 4. The general trend was for the drifters to drift southeast. Individual drifter drift tracks are presented in Appendix 1.
Half-hourly time series of the positions and SST are given in Figure 5 to Figure 11 in Section 3.1.1. Hourly time series of the positions of the coast guard drifters are given in Figure 12 to Figure 17 in Section 3.1.2. The time axes for these coast guard drifter time series are in calendar days rather than in calendar dates. Drift time series (3-hourly) are in Figure 18 to Figure 30 in Section 3.2.

Table 1 2007 Scotian Shelf deployment information

Stn. #	Manufacturer	Argos ID	Date	Deployed (UTC)	Latitude (deg, min)	Longitude (deg, min)
CS1	MetOcean	2750	Oct 11/07	0230	44° 18.2629	63° 15.9600
CS2	MetOcean	2754	Oct 11/07	0832	44° 03.6380	63° 05.7794
CS3	MetOcean	2366	Oct 11/07	1626	43° 41.6655	62° 40.6403
CS4	MetOcean	2345	Oct 11/07	2143	43° 23.4892	62° 19.3751
CS5	MetOcean	10055	Oct 12/07	0250	43° 04.6729	61° 57.9735
M1	MetOcean	3326	Oct 18/07	0525	44° 13.0380	62° 36.9963
M2	MetOcean	17472	Oct 18/07	0853	44° 24.6144	62° 36.9963
CS1	Seimac	17752	Oct 11/07	0315	44° 16.8080	63° 13.9784
CS1	Seimac	17847	Oct 11/07	0630	44° 18.3754	63° 13.9191
CS2	Seimac	17969	Oct 11/07	0832	44° 03.6380	63° 05.7794
CS2	Seimac	17971	Oct 11/07	0923	44° 02.1514	63° 04.2403
CS2	Seimac	17974	Oct 11/07	0944	44° 02.5688	63° 06.0178
CS3	Seimac	19631	Oct 11/07	1626	43° 41.6655	62° 40.6403

Table 2 Basic statistics for 2007 drifter deployment on Scotian Shelf

ID	First Day	Last Day	Total Days	#Data	max North	max South	max East	max West
02345	11 Oct 22:00	29 Nov 07:30	48.3958	2324	43.4855	41.8157	-60.2991	-62.6417
02366	11 Oct 17:30	04 Nov 11:00	23.7291	1140	44.1856	43.6294	-61.1778	-62.8296
02750	11 Oct 05:30	18 Nov 11:30	38.2500	1837	44.2903	41.7259	-60.7353	-64.4076
02754	11 Oct 10:00	16 Dec 15:29	66.2291	3179	44.0967	42.2409	-60.1137	-64.1681
03326	18 Oct 04:30	07 Dec 03:00	49.9375	2398	44.3209	40.1120	-58.3558	-64.8126
10055	12 Oct 02:30	04 Dec 07:30	53.2083	2555	43.0946	40.5105	-59.2985	-64.0247
17472	18 Oct 11:30	06 Nov 19:30	19.3333	929	44.5331	43.8622	-62.9305	-63.4687
17752	10 Oct 03:16	15 Oct 02:16	4.9583	120	44.2800	43.3525	-63.2330	-64.7933
17847	10 Oct 06:15	15 Oct 04:15	4.9167	119	44.3050	43.4037	-63.2320	-64.3106
17969	10Oct 08:16	15 Oct 06:16	4.9167	119	44.0630	43.8520	-63.1000	-63.9756
17971	10 Oct 09:16	15 Oct 07:16	4.9167	119	44.0510	43.7846	-63.0710	-63.7664
17974	10 Oct 09:17	15 Oct 09:17	5.0000	121	44.0498	43.7743	-63.1010	-63.7742
19631	10 Oct 16:15	15 Oct 15:15	4.9583	120	43.8650	43.6835	-62.3755	-62.9118

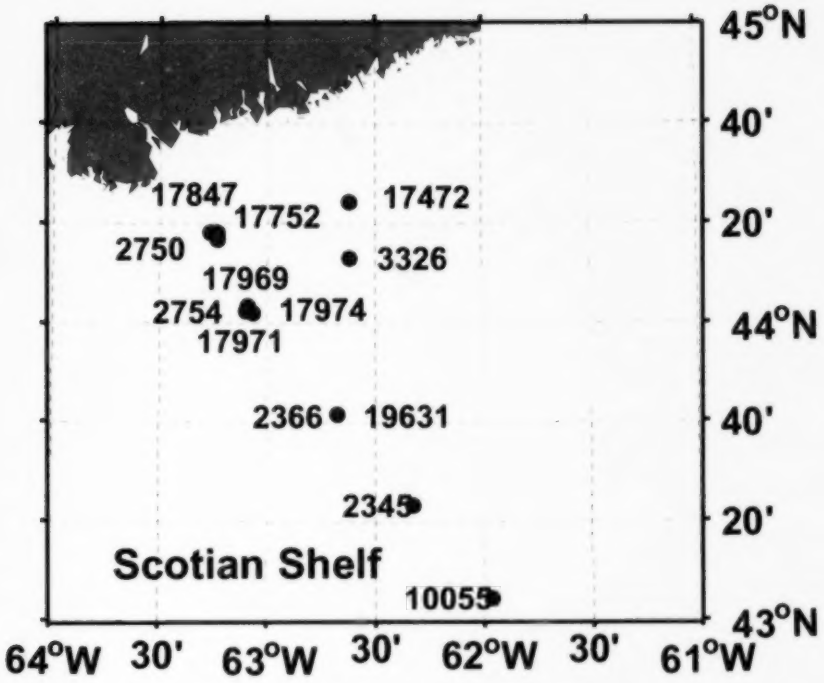

Figure 3 Deployment sites for 2007 drifters on the Scotian Shelf

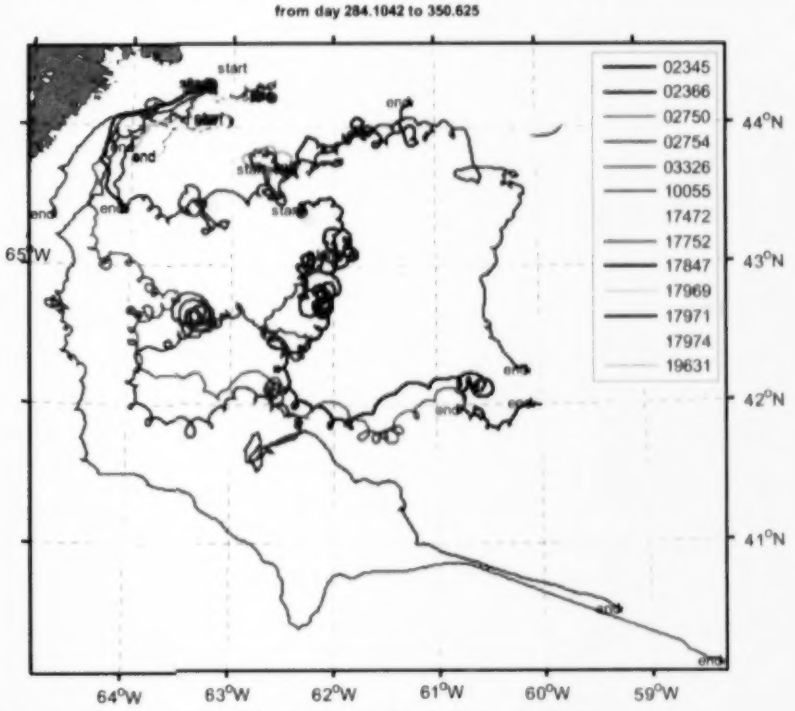

Figure 4 Drift tracks for 2007 drifters on the Scotian Shelf

3.1 2007 drifter time series of positions

3.1.1 MetOcean drifter half-hourly positions

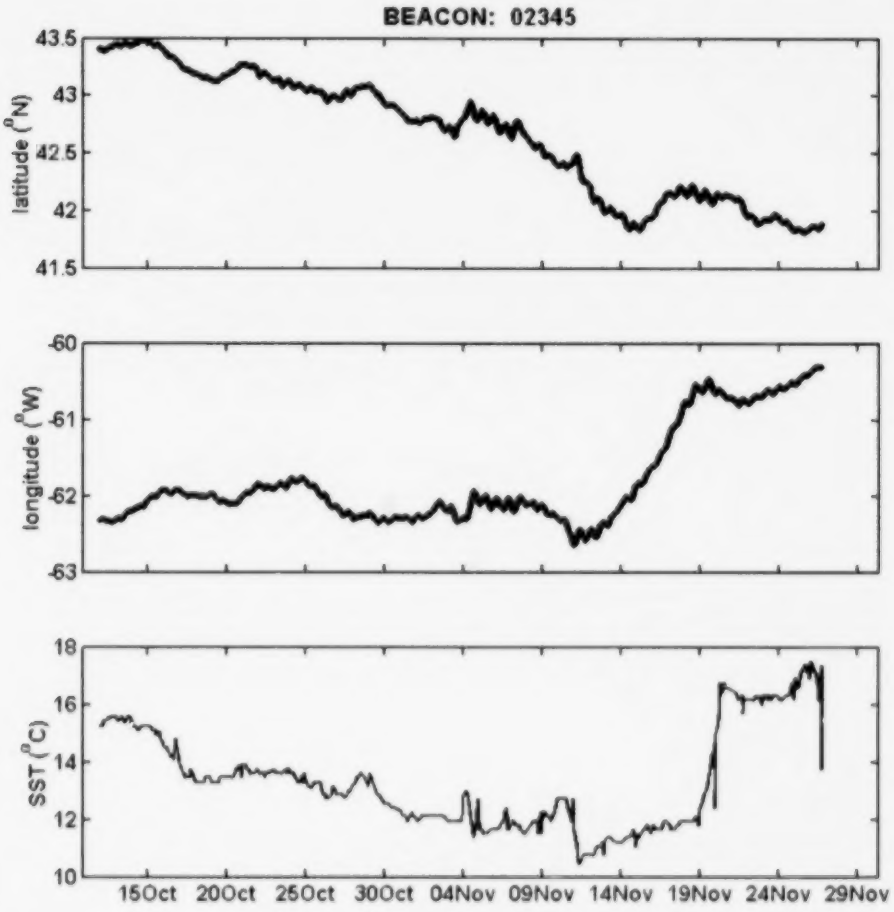

Figure 5 Interpolated half-hourly Position and SST for drifter 02345

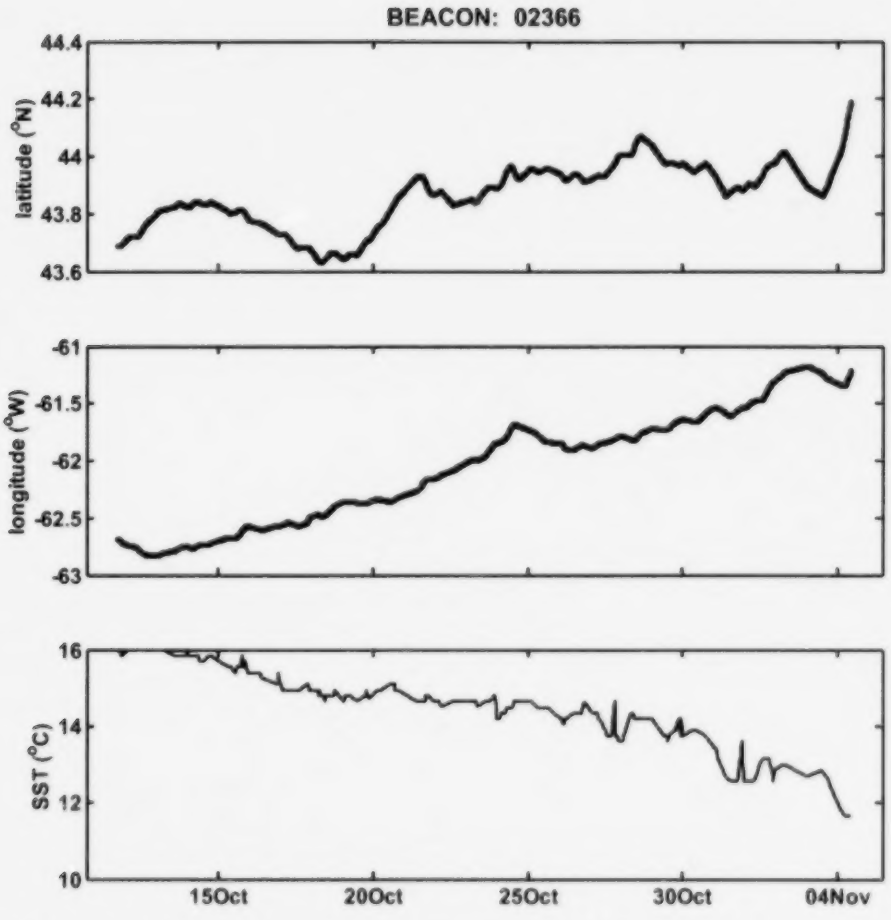

Figure 6 Interpolated half-hourly Position and SST for drifter 02366

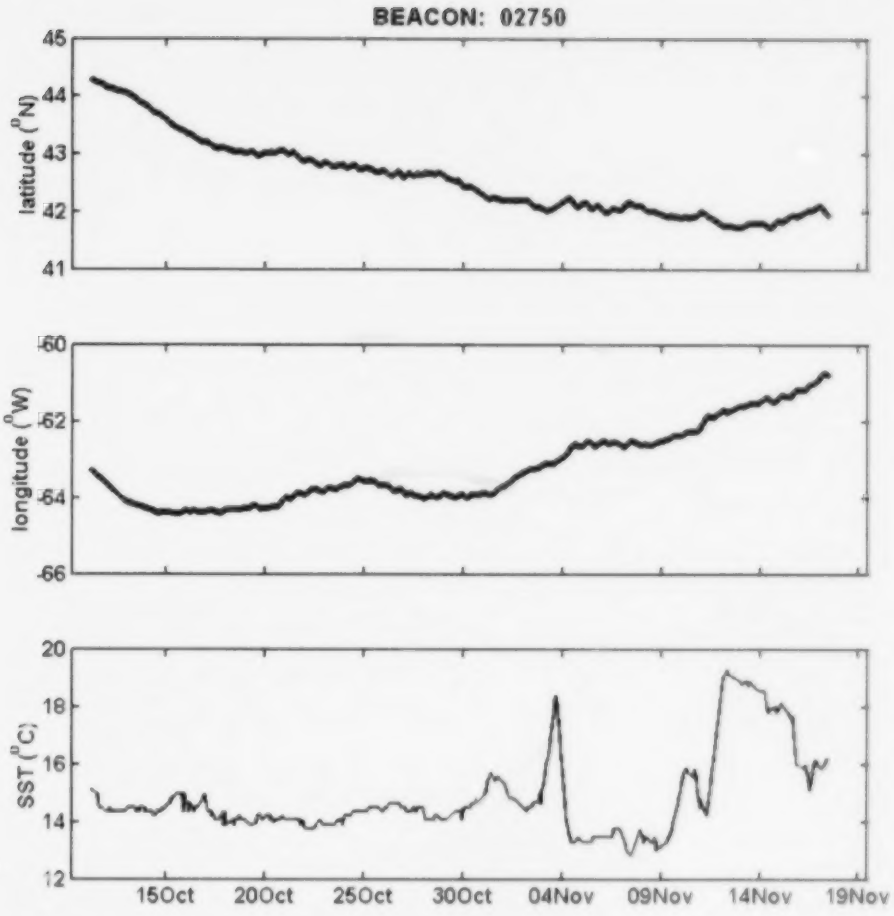

Figure 7 Interpolated half-hourly Position and SST for drifter 02750

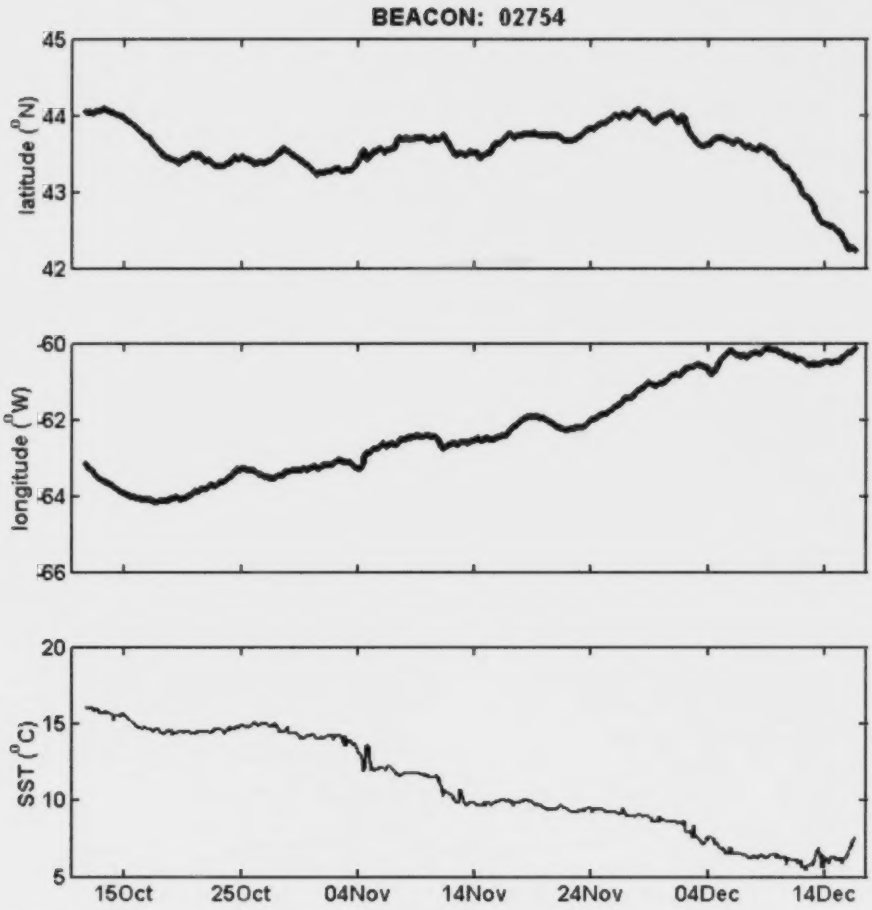

Figure 8 Interpolated half-hourly Position and SST for drifter 02754

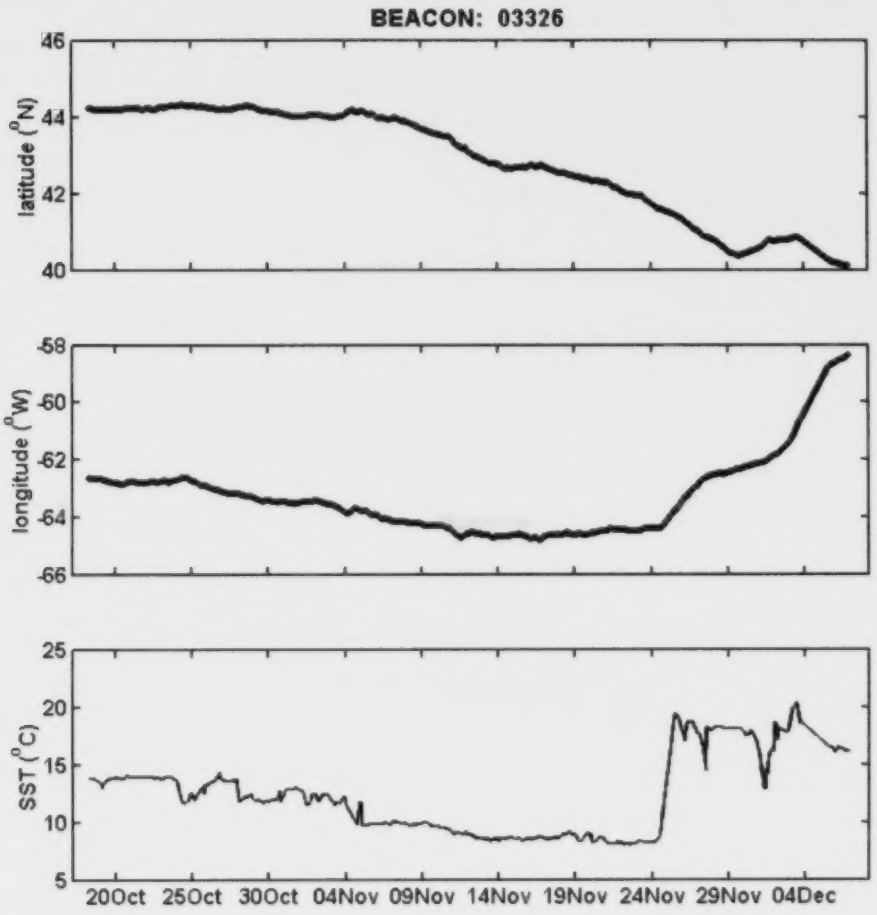

Figure 9 Interpolated half-hourly Position and SST for drifter 03326

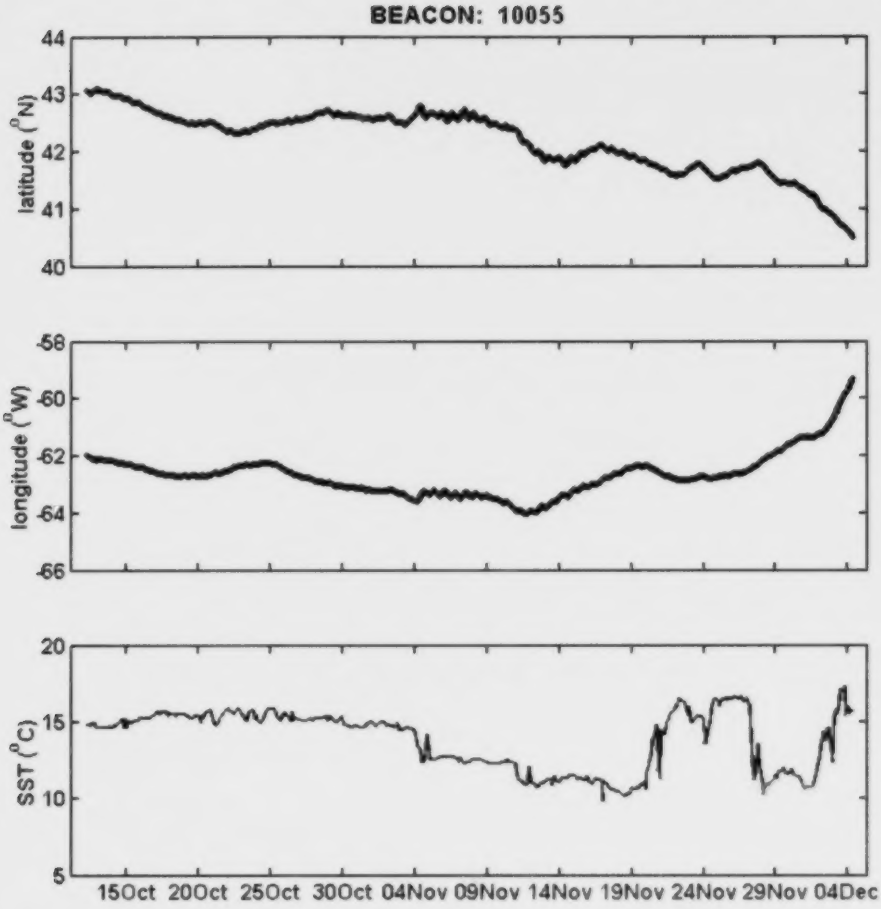

Figure 10 Interpolated half-hourly Position and SST for drifter 10055

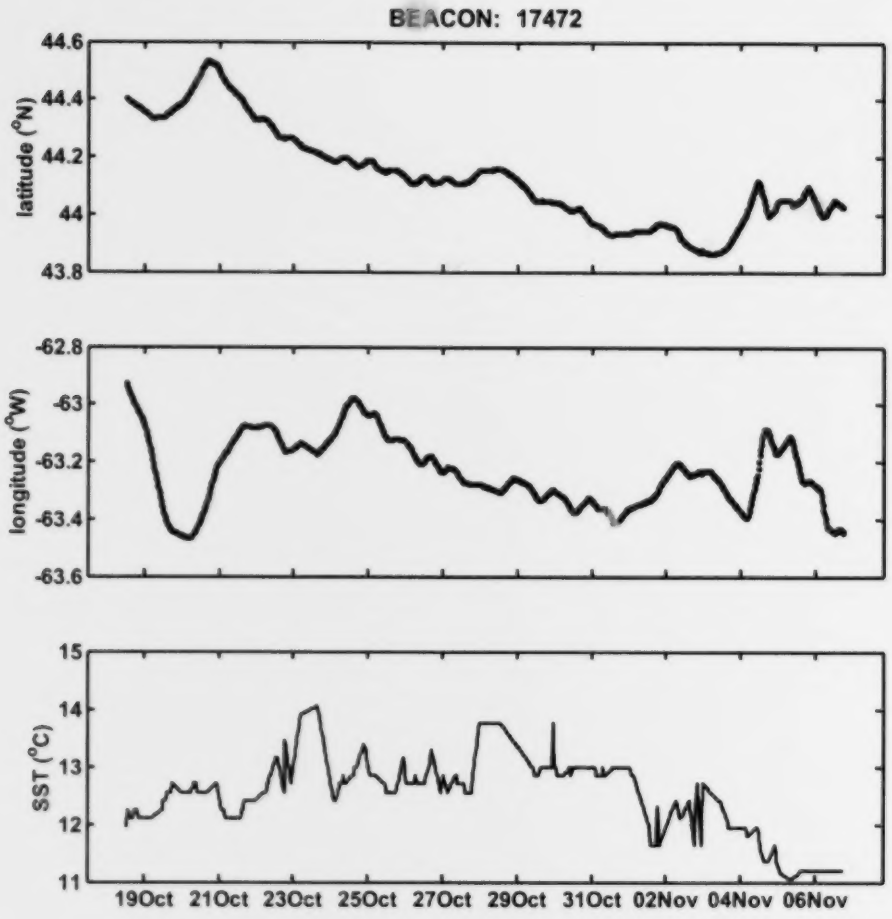

Figure 11 Interpolated half-hourly Position and SST for drifter 17472

3.1.2 Seimac drifter hourly positions

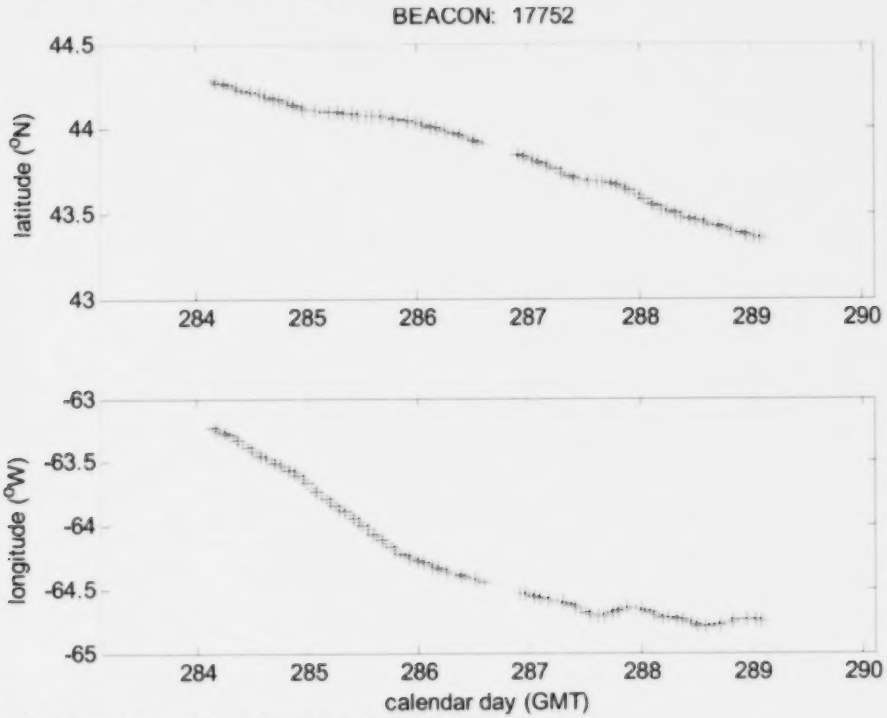

Figure 12 Hourly Position data for drifter 17752

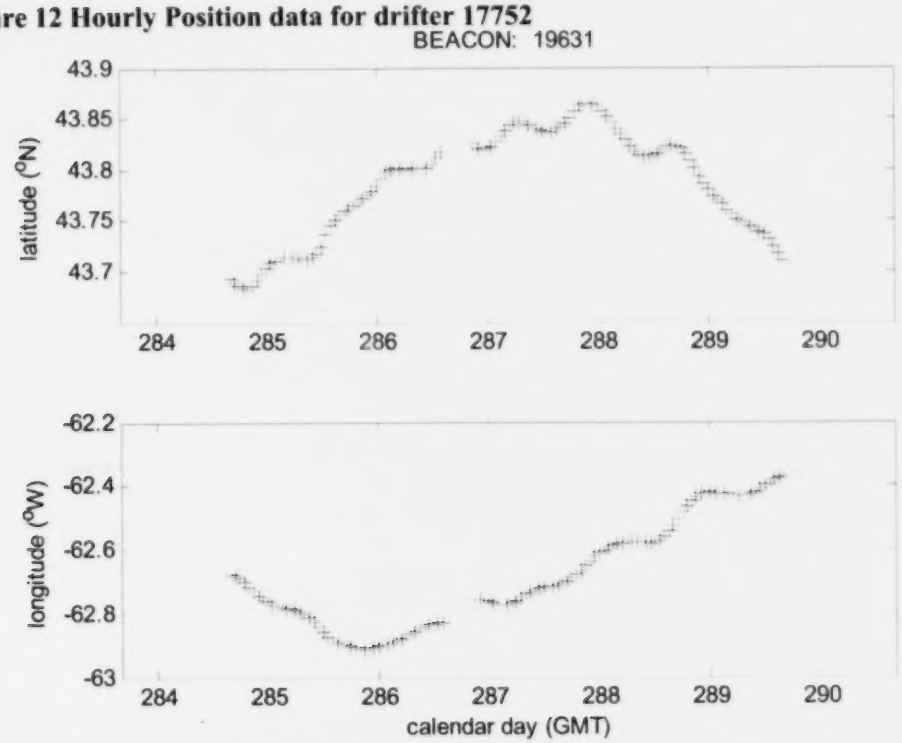

Figure 13 Hourly Position data for drifter 19631

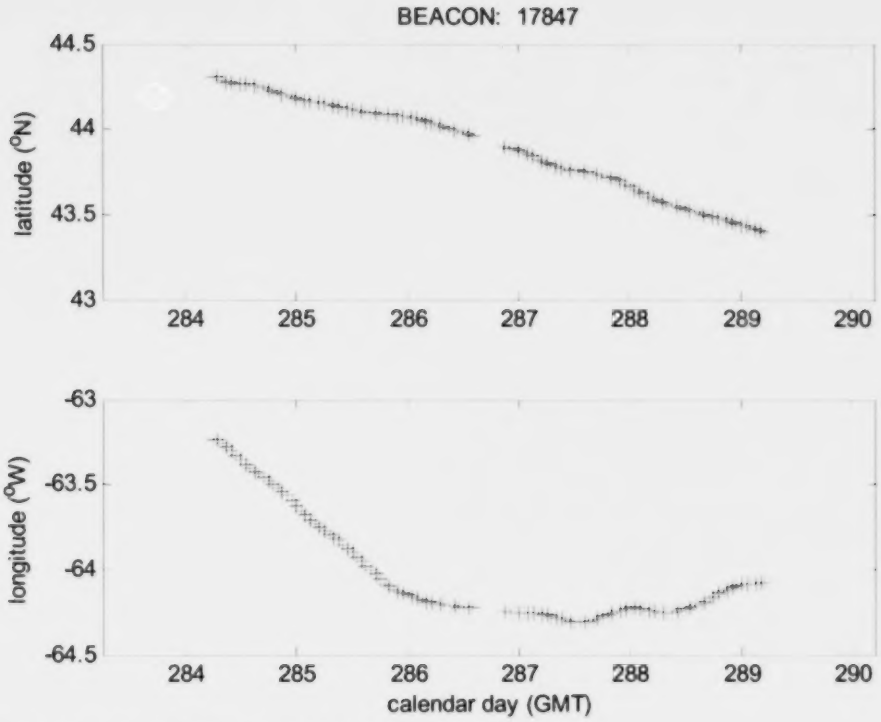

Figure 14 Hourly Position data for drifter 17847

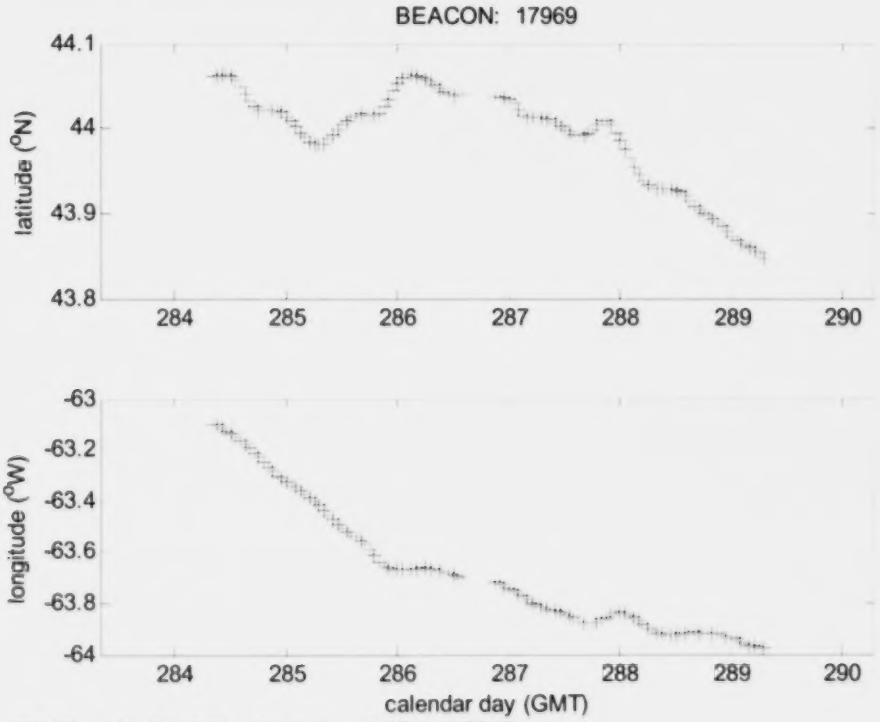

Figure 15 Hourly Position data for drifter 17969

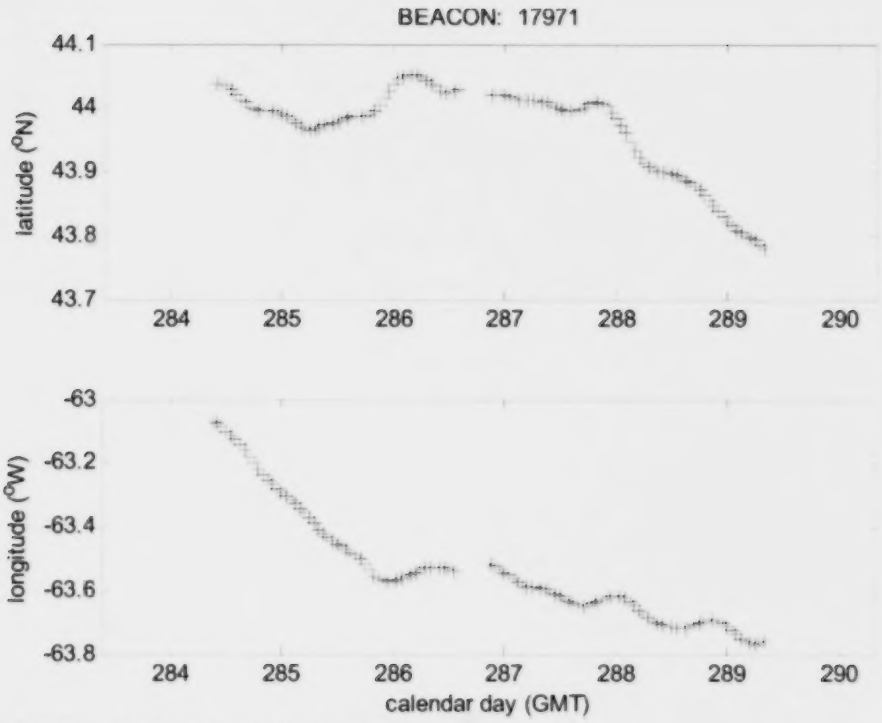

Figure 16 Hourly Position data for drifter 17971

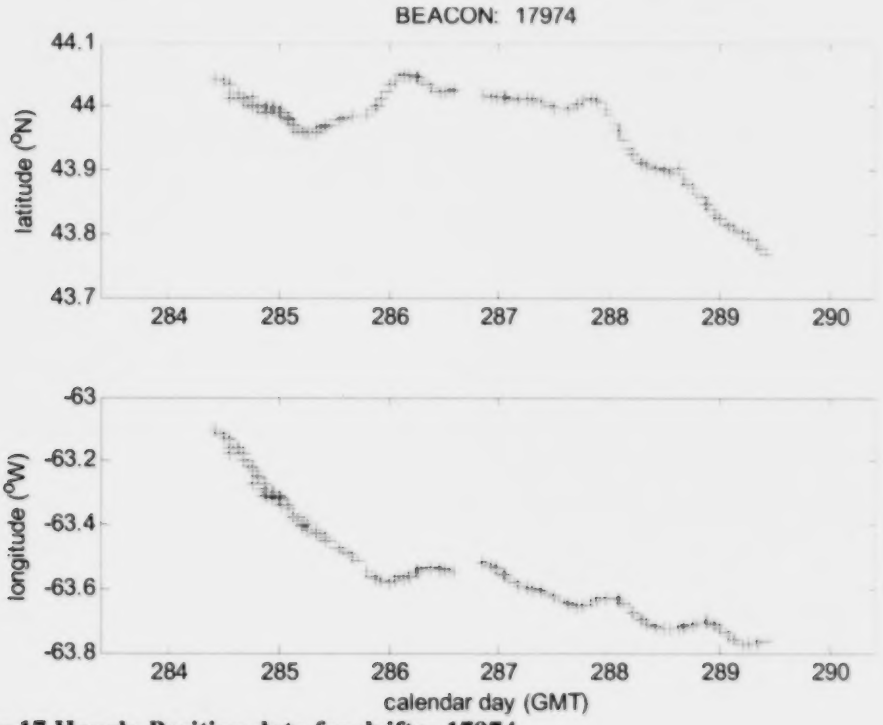

Figure 17 Hourly Position data for drifter 17974

3.2 2007 drifter drift

Basic statistics for 3-hourly drift speeds are given in Table 3. Statistics of drift speed were computed for components computed using the polynomial fit method. Data are lost at the beginning and the end of the complete drift record, depending on the size of the sampling interval and the statistics for drifter drift will reflect this. Table 4 gives the minimum, maximum, and mean of the measured sea surface temperature from the MetOcean drifters.

Table 3 Basic statistics for 3-hourly drift velocity

ID	total distance (km)	min U (m/s)	max U (m/s)	mean U (m/s)	min V (m/s)	max V (m/s)	mean V (m/s)
02345	255.8211	-0.7863	0.9099	0.0441	-0.8135	0.5800	-0.0349
02366	384.5275	-0.3162	0.6434	0.0638	-0.2350	0.5215	0.0211
02750	1117.3726	-0.7774	0.9808	0.0660	-0.5492	0.5406	-0.0616
02754	1363.5407	-0.6831	1.3833	0.0451	-0.6303	0.4153	-0.0271
03326	1391.1232	-0.5675	1.4336	0.0857	-0.5009	0.4531	-0.0825
10055	1606.4408	-0.9315	1.3352	0.0489	-0.7749	0.6238	-0.0475
17472	368.8632	-0.6239	0.9973	-0.0262	-0.5130	0.3597	-0.0185
17752	185.4794	-0.7986	0.3404	-0.3049	-0.4009	-0.0216	-0.1884
17847	164.0115	-0.6946	0.3510	-0.1778	-0.4034	-0.0236	-0.1833
17969	98.2887	-0.5235	0.2480	-0.1777	-0.2460	0.1898	-0.0414
17971	98.0345	-0.4718	0.1947	-0.1464	-0.2939	0.2640	-0.0509
17974	98.4774	-0.4931	0.1749	-0.1273	-0.2854	0.2559	-0.0580
19631	84.2629	-0.4068	0.5092	0.0611	-0.1835	0.1593	0.0054

Table 4 Basic statistics for sea surface temperature measured by 2007 GPS drifters

ID	Min SST	Max SST	Mean SST
02345	10.4500	17.5000	13.3235
02366	11.6500	16.0000	14.4170
02750	12.8500	19.3000	14.8453
02754	5.5000	16.0700	10.9388
03326	8.0500	20.3500	12.3656
10055	9.8500	17.3500	13.8043
17472	11.0500	14.0500	12.5430

Plots for 3-hourly drift speeds, for drifts computed using a polynomial fit smoothing algorithm, are presented in Figures 15-27.

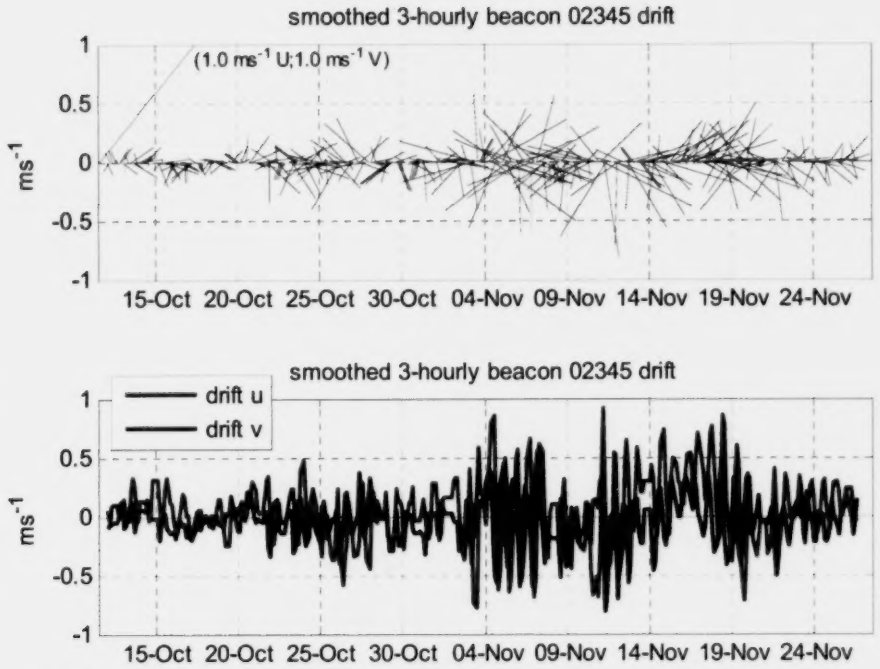

Figure 18 3-hourly drift data for drifter 02345; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

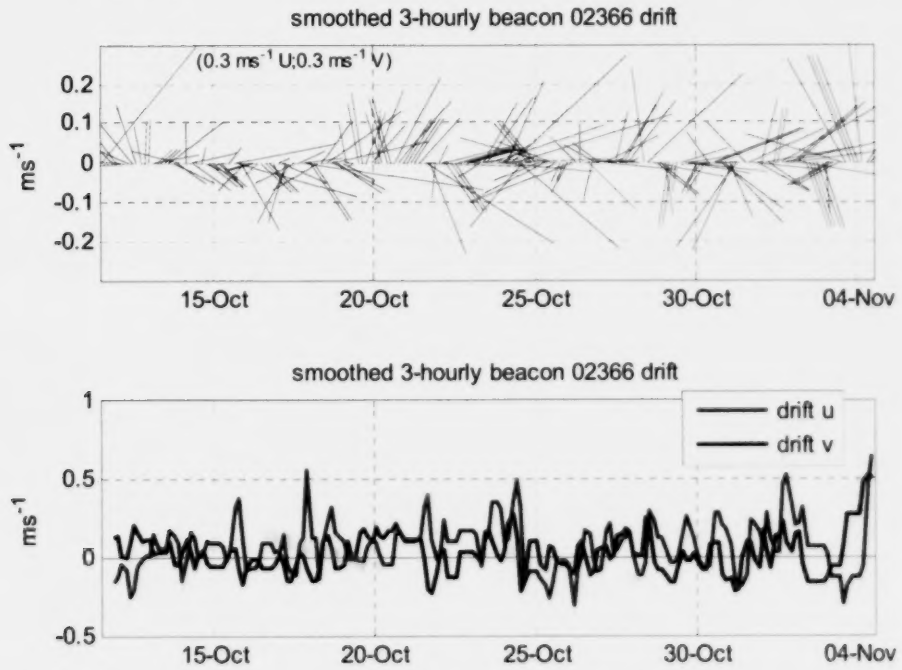

Figure 19 3-hourly drift data for drifter 02366; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

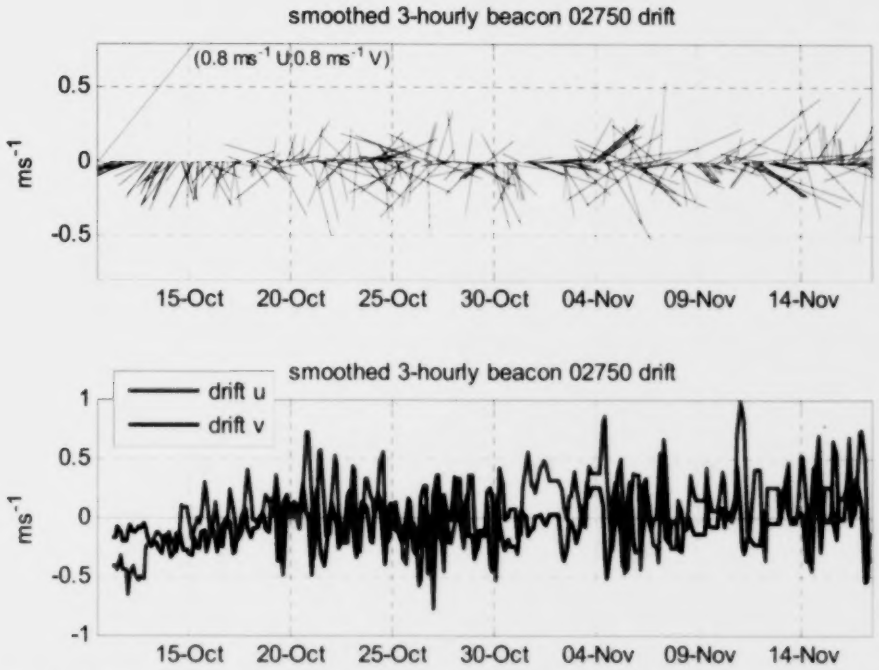

Figure 20 3-hourly drift data for drifter 02750; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

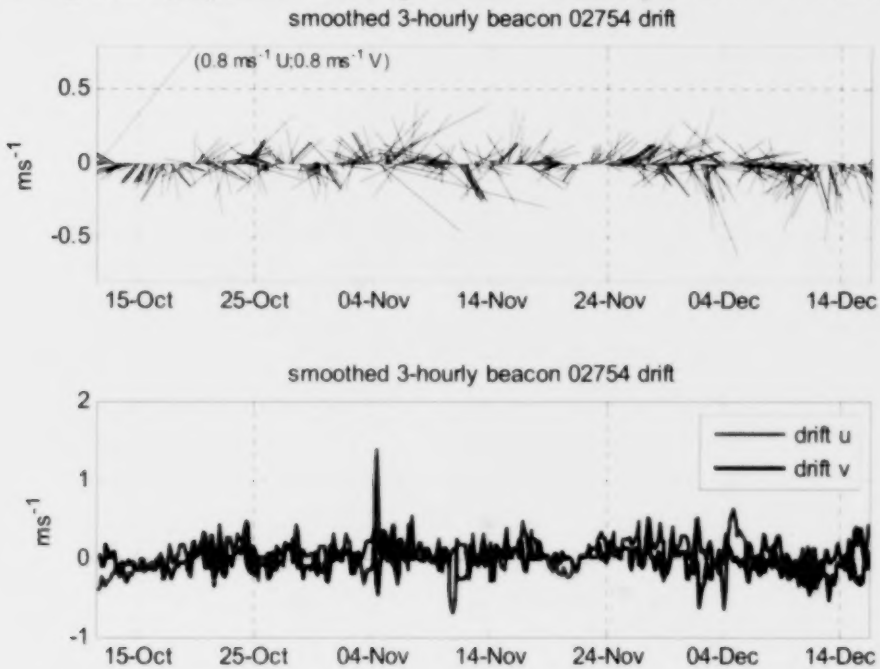

Figure 21 3-hourly drift data for drifter 02754; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

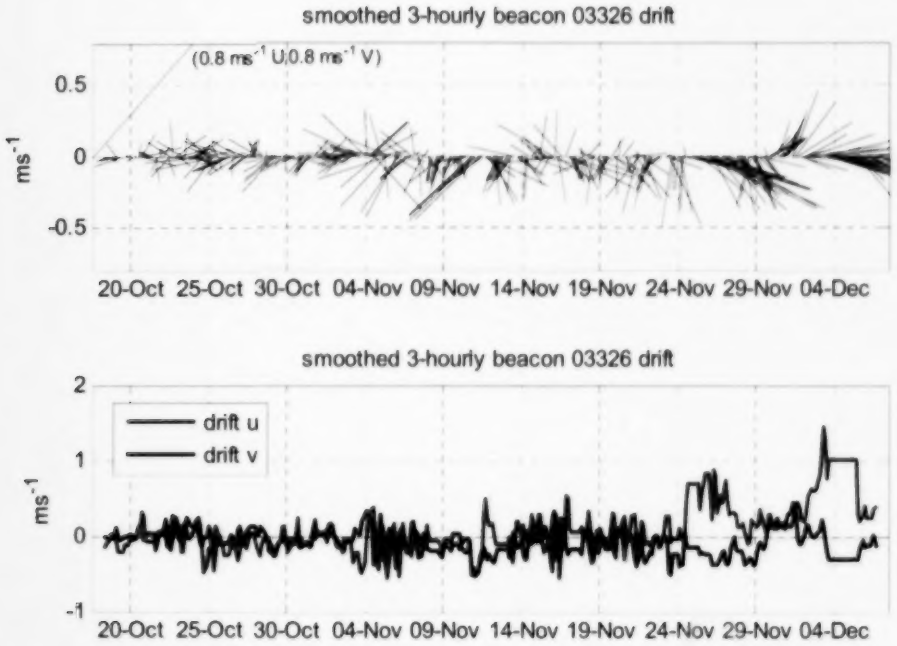

Figure 22 3-hourly drift data for drifter 03326; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

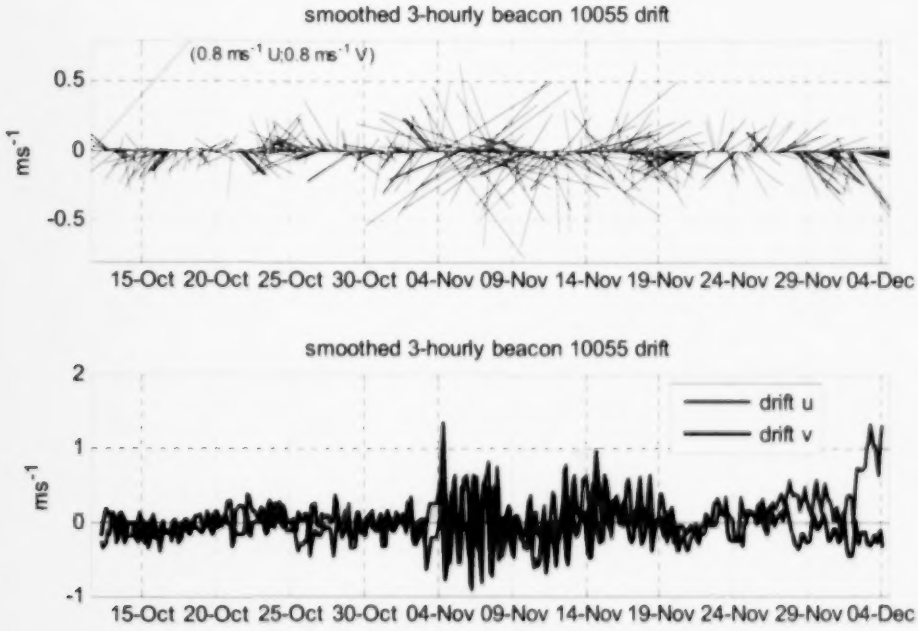

Figure 23 3-hourly drift data for drifter 10055; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

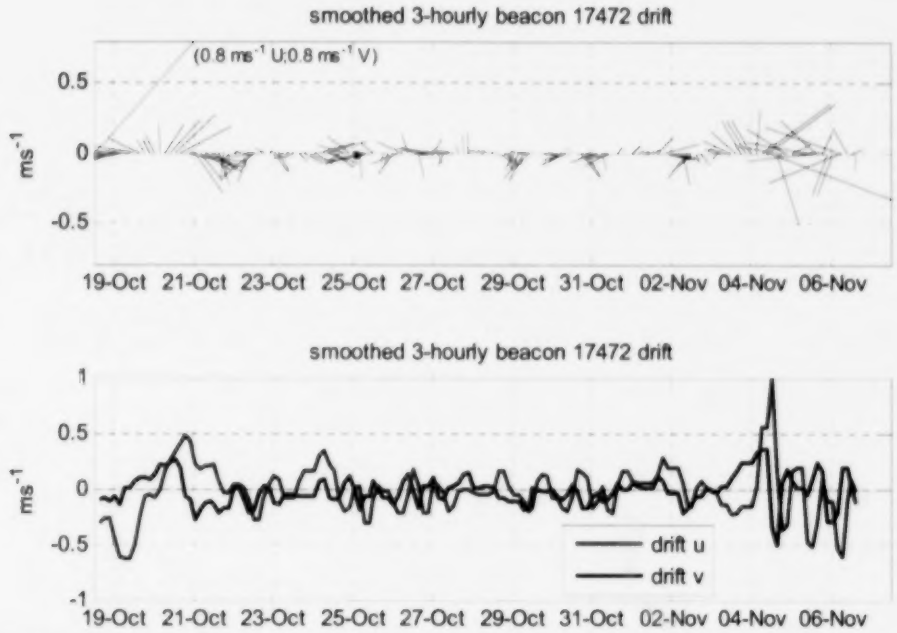

Figure 24 3-hourly drift data for drifter 17472; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

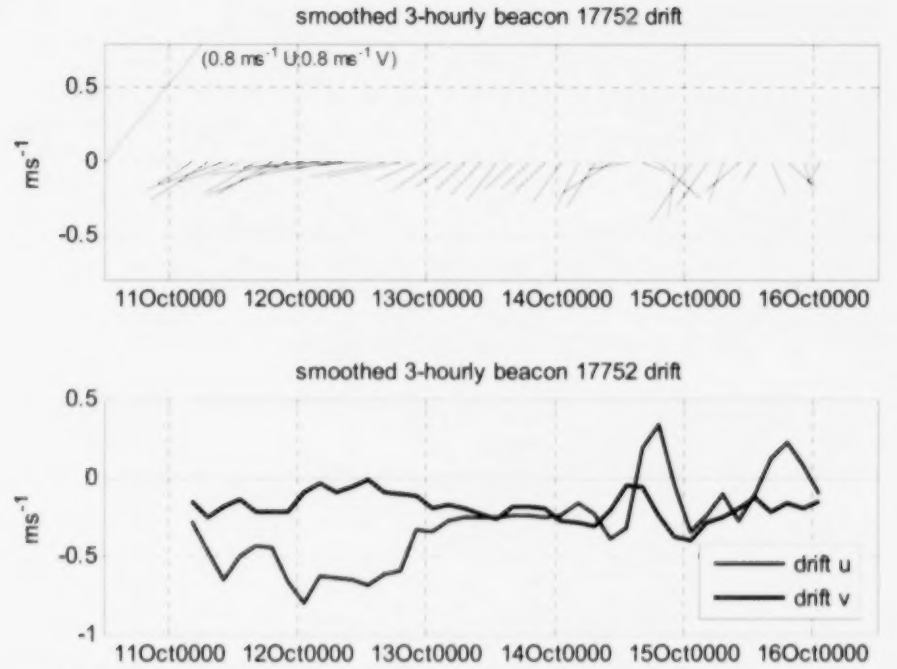

Figure 25 3-hourly drift data for drifter 17752; the drift was computed by smoothing with a polynomial fit using a 3 hour window

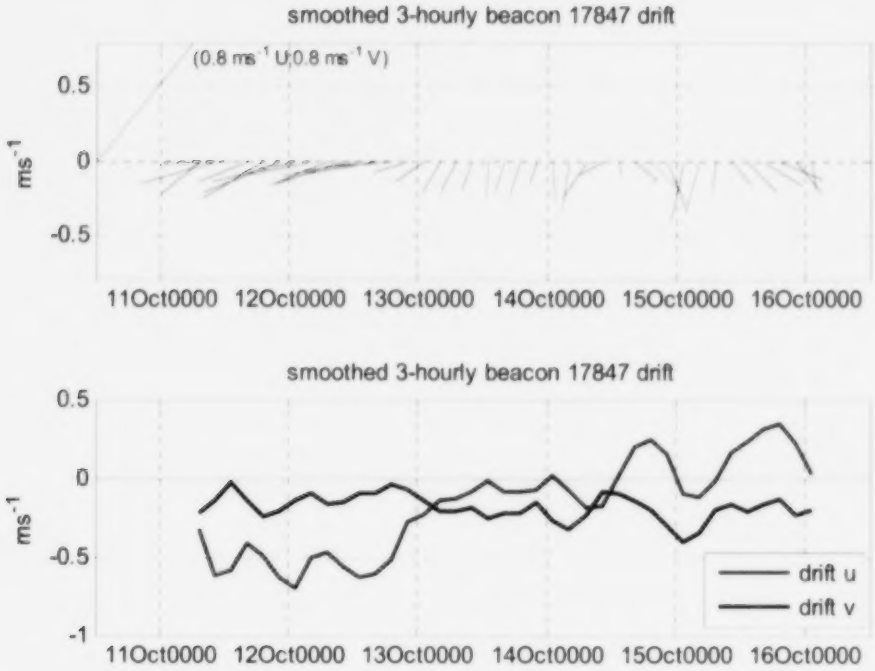

Figure 26 3-hourly drift data for drifter 17847; the drift was computed by smoothing with a polynomial fit using a 3 hour window

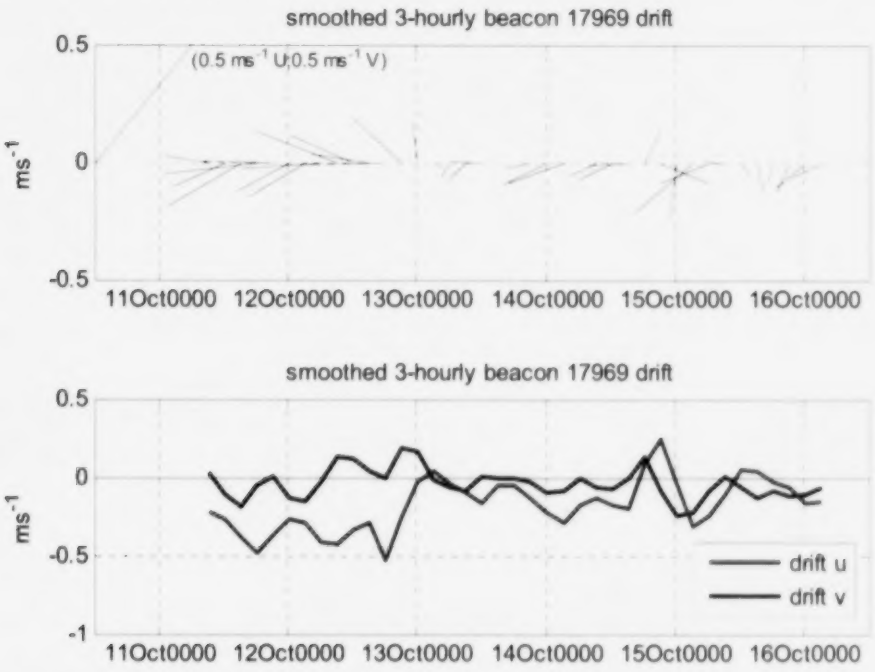

Figure 27 3-hourly drift data for drifter 17969; the drift was computed by smoothing with a polynomial fit using a 3 hour window

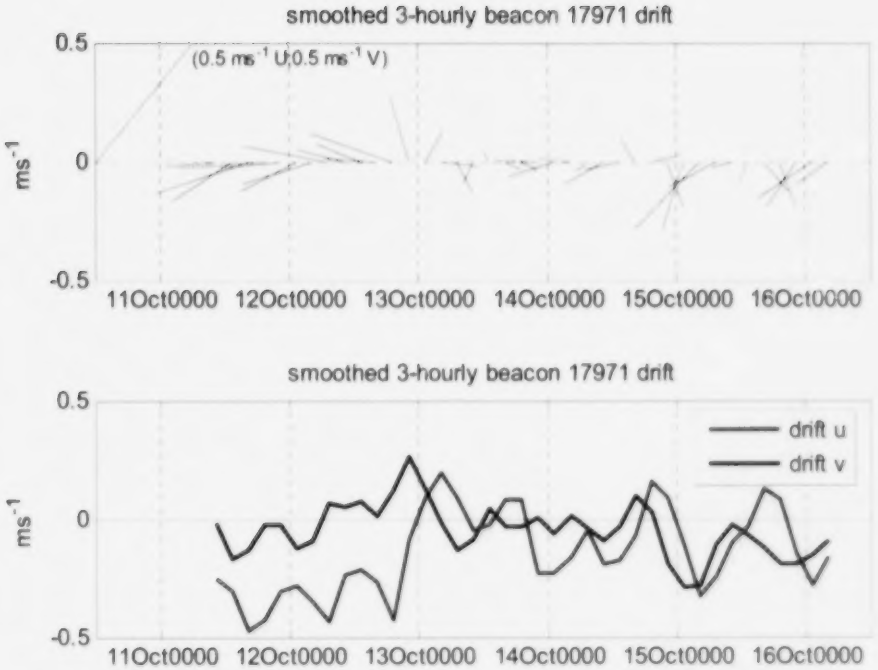

Figure 28 3-hourly drift data for drifter 17971; the drift was computed by smoothing with a polynomial fit using a 3 hour window

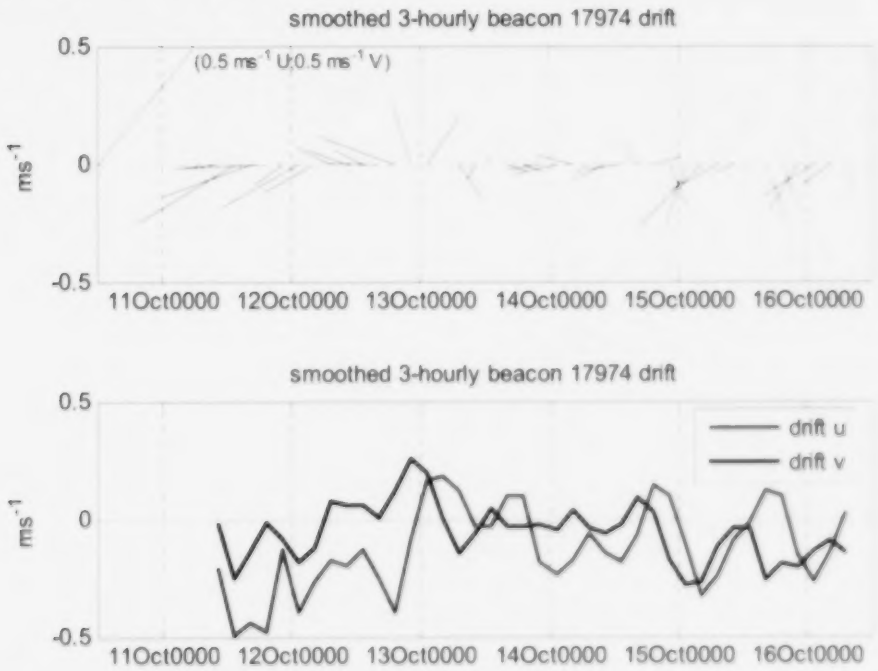

Figure 29 3-hourly drift data for drifter 17974; the drift was computed by smoothing with a polynomial fit using a 3 hour window

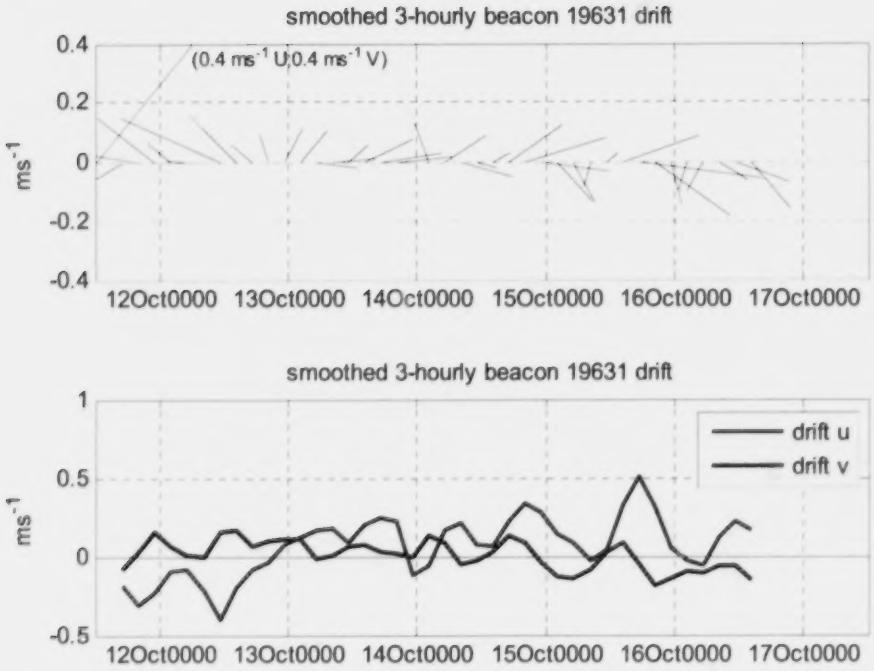

Figure 30 3-hourly drift data for drifter 19631; the drift was computed by smoothing with a polynomial fit using a 3 hour window

4 2008 Gulf of St. Lawrence Drifters

The deployment information for the drifters (both MetOcean and Seimac drifters) is listed in Table 5, and the deployment sites are shown in Figures 2, 31-36. Basic statistics for the 2008 deployment are given in Table 6.

Table 5 2008 Gulf of St. Lawrence deployment information

Stn.#	Manufacturer	Argos ID	Date	Deployed (UTC)	Latitude (deg)	Longitude (deg)	Water depth
Cabot Strait West							
C2	Seimac	17303	16Oct 08	0243	47.19343	60.58091	176m
C3	Seimac	17304	16Oct 08	0251	47.19358	60.57911333	176m
C4	Seimac	17305	16Oct 08	0316	47.16476333	60.62626167	186m
C5	Seimac	17306	16Oct 08	0318	47.16503667	60.62664667	186m
C6	Seimac	17307	16Oct 08	0348	47.13558833	60.57071	175m
C7	Seimac	17308	16Oct 08	0351	47.135995	60.569685	175m
C8	Seimac	17309	16Oct 08	0407	47.16698667	60.53096667	-
C9	Seimac	17310	16Oct 08	0410	47.16723	60.53071	-
Cabot Strait East							
MO	MetOcean	87784	16Oct 08	0915	47.83344167	59.58293	321m
S0	Seimac	17311	16Oct 08	0934	47.83323167	59.599075	343m
S1	Seimac	17313	16Oct 08	0935	47.83310333	59.599755	348m
S2	Seimac	17330	16Oct 08	0955	47.84441	59.58521833	309m
S3	Seimac	17746	16Oct 08	1016	47.83369	59.56836	288m
S4	Seimac	17747	16Oct 08	1029	47.82143167	59.582765	341m
S5	Seimac	17748	16Oct 08	1030	47.82141333	59.58321167	343m

Honguedo Strait (Gaspe)							
Q1	MetOcean	87785	6Nov 08	1725	49.4075	64.6655	355m
Q2	MetOcean	87786	6Nov 08	1740	49.41616667	64.64916667	335m
Q3	MetOcean	87787	6Nov 08	1735	49.42566667	64.6655	-
Q4	MetOcean	87788	6Nov 08	1730	49.41683333	64.684	-
Northumberland Strait (PEI)							
P1	MetOcean	87789	18Nov 08	1353	46.15674667	62.0084133	46m
P2	MetOcean	87790	18Nov 08	1359	46.15505167	61.9881350	48m
P3	MetOcean	87791	18Nov 08	1405	46.14236	61.9929500	42m
P4	MetOcean	87792	18Nov 08	1409	46.14455167	62.0116950	48m

Table 6 Basic statistics for 2008 drifter deployment in the Gulf of St. Lawrence

ID	First Day	Last Day	Total Days	#Data	max North	max South	max East	max West
87784	17 Oct 09:30	19 Oct 06:00	1.8542	90	47.9437	47.8325	-59.3237	-59.5831
87785	06 Nov 19:30	15 Jan 14:30	69.7917	3351	49.3895	46.5826	-58.3880	-64.6153
87786	06 Nov 18:30	17 Nov 12:30	10.7500	517	49.4102	48.3930	-62.9721	-64.6288
87787	06 Nov 18:00	23 Dec 18:30	47.0208	2258	49.9997	47.4502	-62.4386	-67.6784
87788	07 Nov 04:30	13 Jan 15:30	67.4583	3239	49.9988	45.8006	-58.8501	-67.0785
87789	18 Nov 15:00	22 Dec 12:00	33.8750	1627	47.6174	45.4383	-58.7520	-62.0444
87790	18 Nov 16:30	22 Dec 16:00	33.9792	1632	47.6534	46.0172	-58.3182	-62.0105
87791	18 Nov 15:00	10 Jan 12:00	52.8750	2539	47.5230	45.9608	-55.4690	-62.0082
87792	19 Nov 01:30	31 Dec 21:00	42.8125	2056	48.4682	46.0096	-57.6666	-62.0104
17303	16 Oct 02:15	21 Oct 00:15	4.9167	119	47.2132	46.0296	-59.0385	-60.6195
17304	15 Oct 14:18	21 Oct 01:18	5.4583	132	47.2135	45.9332	-59.0973	-60.6163
17305	16 Oct 03:15	20 Oct 22:15	4.7917	116	47.1978	46.2090	-58.9150	-60.6798
17306	16 Oct 03:15	21 Oct 01:15	4.9167	119	47.1985	45.9160	-59.1304	-60.6808
17307	16 Oct 03:15	21 Oct 01:15	4.9167	119	47.2765	45.9704	-59.1808	-60.5660

17308	16 Oct 03:15	21 Oct 01:15	4.9167	119	47.2765	45.9804	-59.1495	-60.5680
17309	16 Oct 04:12	18 Oct 01:12	1.8750	46	47.2506	47.1670	-60.1433	-60.5300
17310	16 Oct 04:15	18 Oct 00:15	1.8333	45	47.2500	47.1670	-60.1450	-60.5300
17311	16 Oct 09:15	21 Oct 08:15	4.9583	120	47.9658	47.6390	-59.3070	-59.5980
17313	16 Oct 09:15	21 Oct 08:15	4.9583	120	47.9628	47.5207	-59.3022	-59.5990
17330	16 Oct 10:04	21 Oct 08:04	4.9167	119	48.0020	47.4420	-59.4231	-59.9053
17746	16 Oct 10:15	18 Oct 10:15	2.0000	49	47.9700	47.8350	-59.3361	-59.5680
17747	16 Oct 10:15	18Oct 07:15	1.8750	46	47.9728	47.8220	-59.3140	-59.5820
17748	16 Oct 10:15	18 Oct 08:15	1.9167	47	47.9728	47.8220	-59.3123	-59.5820

Drift tracks for the 2008 drifters are shown in Figure 32 for those that were released off the Gaspe Peninsula. Drift tracks for the 2008 drifters are shown in Figure 34 for those that were released off the Prince Edward Island in the eastern Northumberland Strait. Drift tracks for the 2008 coast guard drifters are shown in Figure 37 for those that were released in Cabot Strait. The general trend was for the drifters to drift to Cabot Strait and out onto the shelf. Individual drifter drift tracks are presented in Appendix 2.

Half-hourly time series of the positions and SST are given in Figure 5 to Figure 46 in Section 4.1. Hourly time series of the positions of the coast guard drifters are given in Figure 47 to Figure 60 in Section 4.1. The time axes for these coast guard drifter time series are in calendar days rather than in calendar dates. Drift time series (3-hourly) are in Figure 61 to Figure 78 in Section 4.2. Drifter 87786 crashed into Anticosti Island on November 17 so the data were truncated to 12:30 pm on that day.

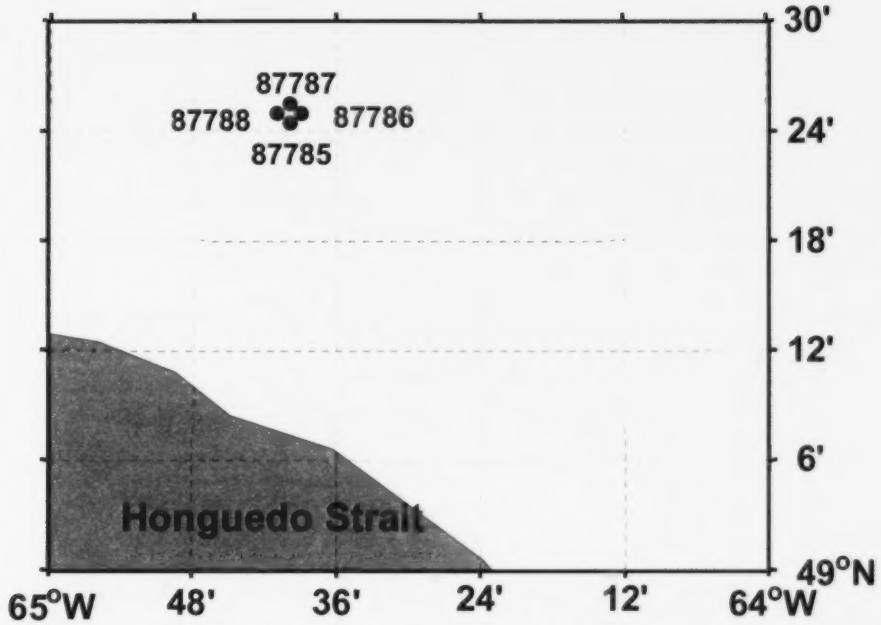

Figure 31 Deployment sites for 2008 drifters in the Honguedo Strait of the Gulf of St. Lawrence

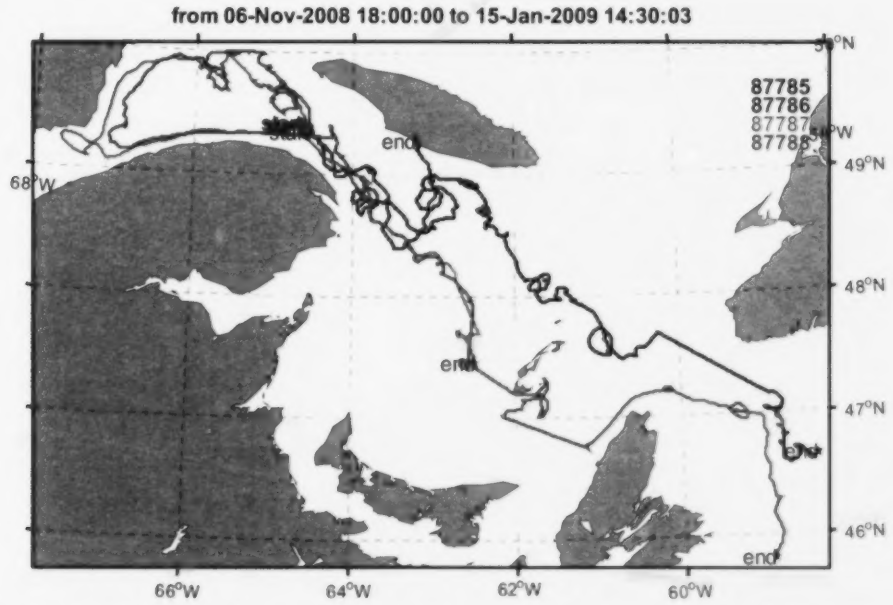

Figure 32 Drift tracks for 2008 drifters in the Gulf of St. Lawrence. The drifters were released off the Gaspe Peninsula in the Honguedo Strait.

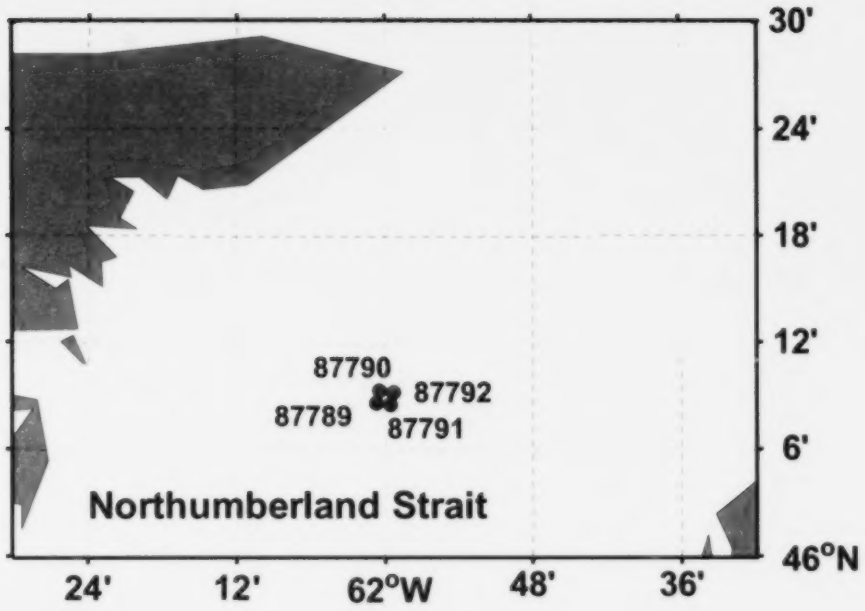

Figure 33 Deployment sites for 2008 drifters in eastern Northumberland Strait

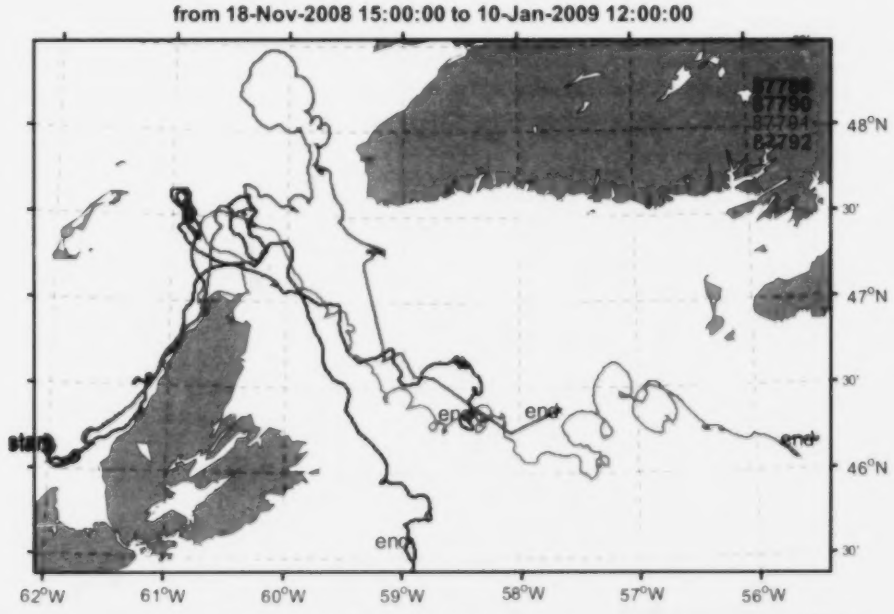

Figure 34 Drift tracks for 2008 drifters in the Gulf of St. Lawrence; the drifters were released off Prince Edward Island in the eastern Northumberland Strait

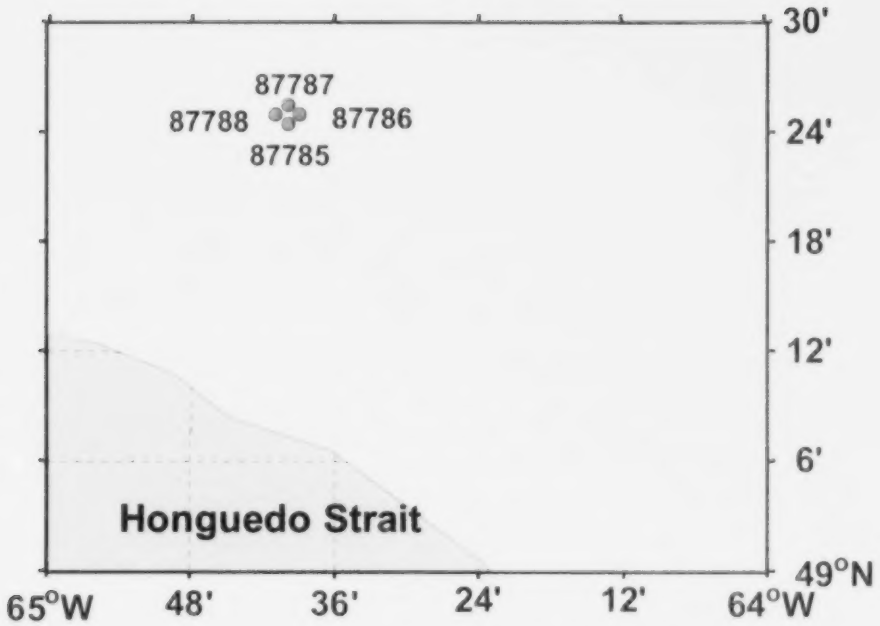

Figure 31 Deployment sites for 2008 drifters in the Honguedo Strait of the Gulf of St. Lawrence

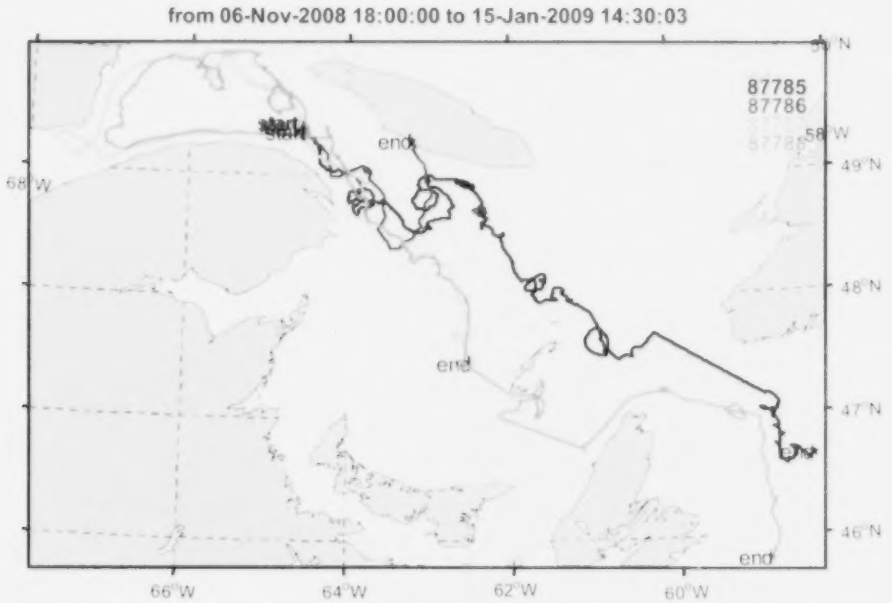

Figure 32 Drift tracks for 2008 drifters in the Gulf of St. Lawrence. The drifters were released off the Gaspe Peninsula in the Honguedo Strait.

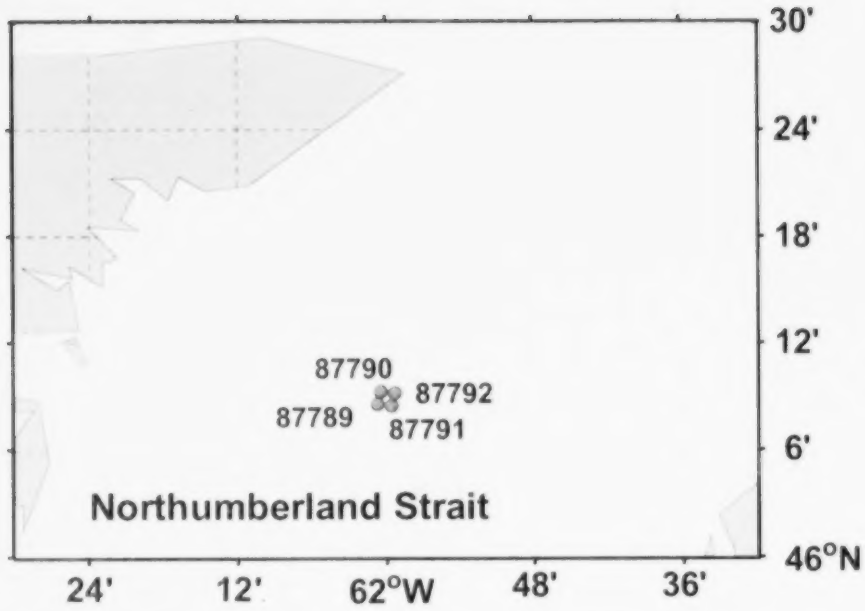

Figure 33 Deployment sites for 2008 drifters in eastern Northumberland Strait

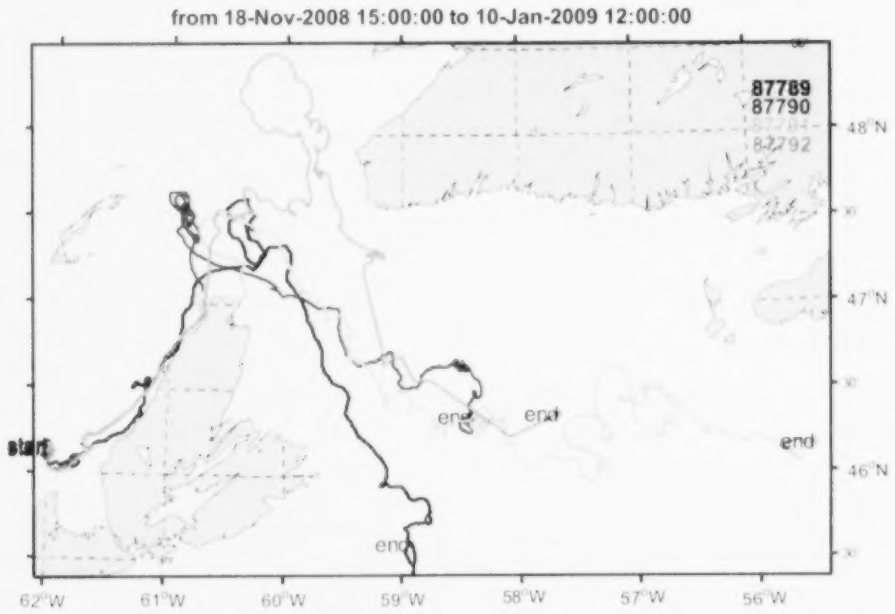

Figure 34 Drift tracks for 2008 drifters in the Gulf of St. Lawrence; the drifters were released off Prince Edward Island in the eastern Northumberland Strait

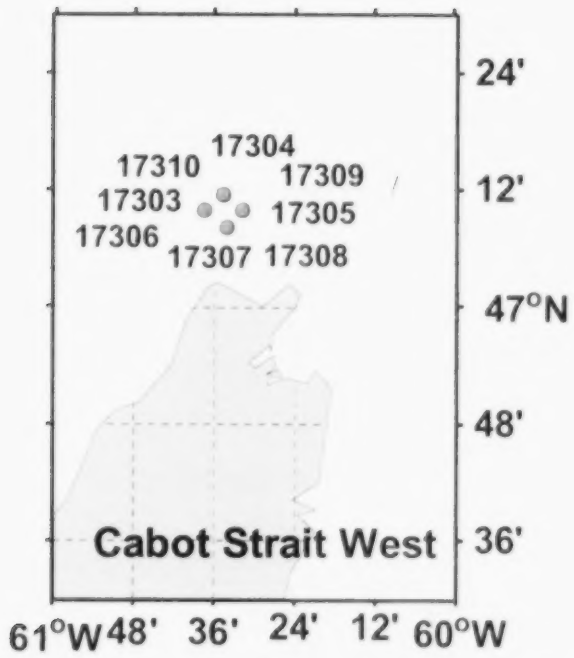

Figure 35 Deployment sites for 2008 drifters in western Cabot Strait off Cape Breton

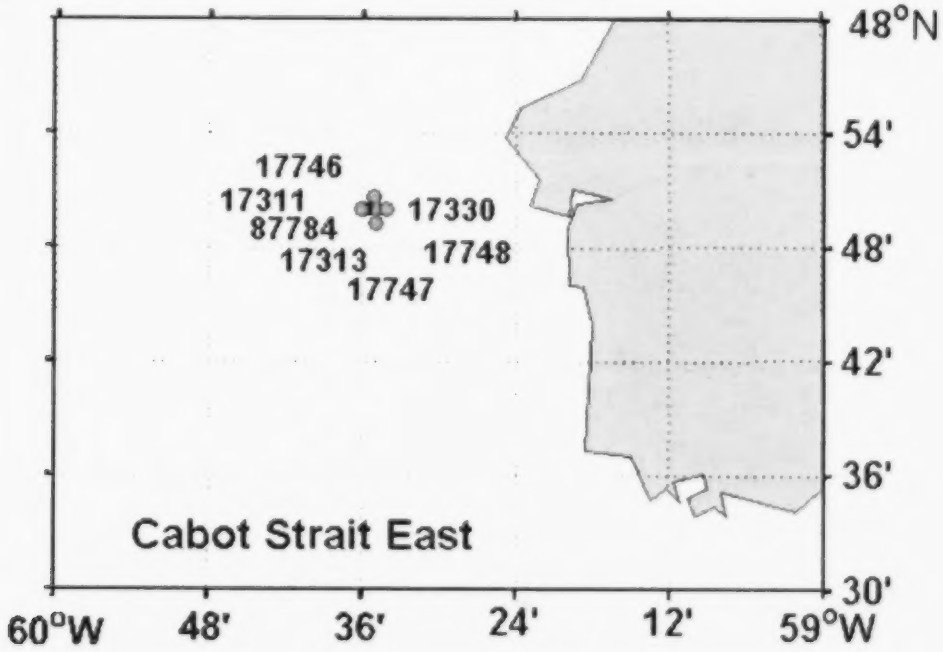

Figure 36 Deployment sites for 2008 drifters in eastern Cabot Strait off southwestern Newfoundland

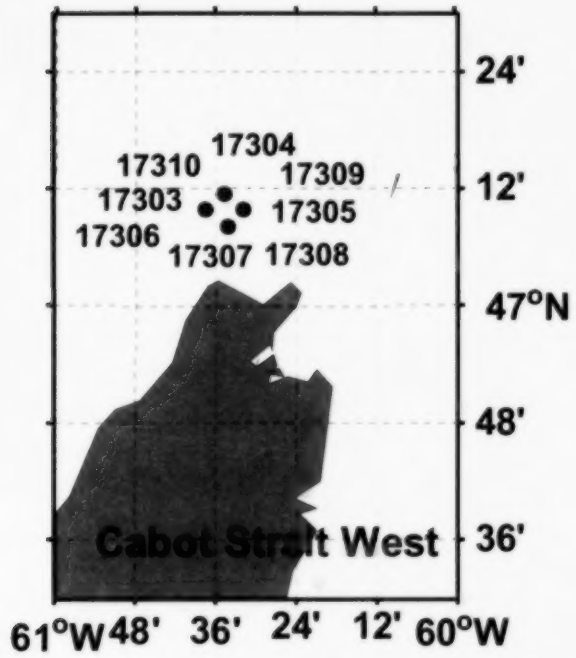

Figure 35 Deployment sites for 2008 drifters in western Cabot Strait off Cape Breton

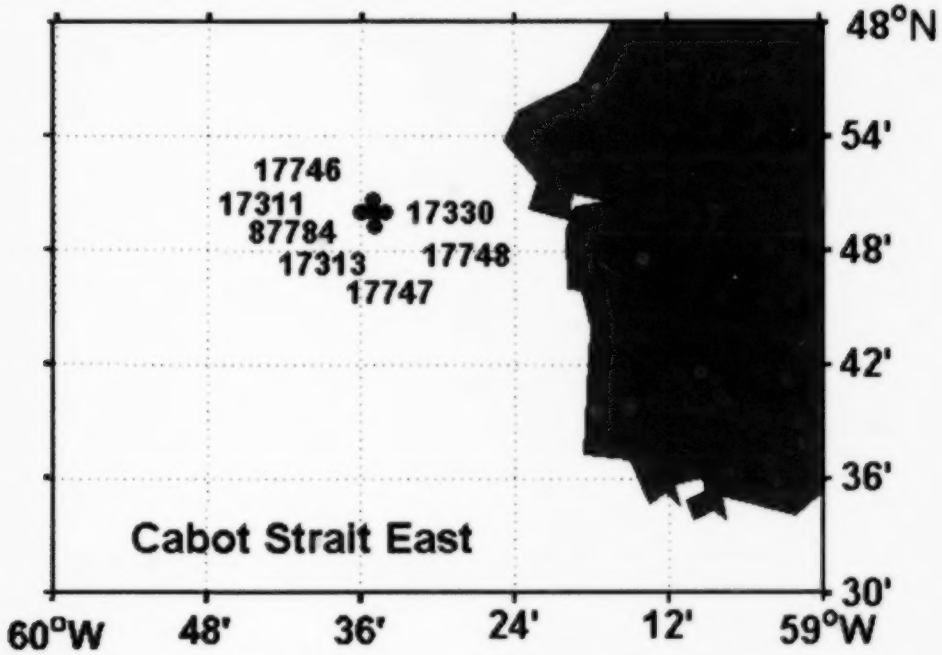

Figure 36 Deployment sites for 2008 drifters in eastern Cabot Strait off southwestern Newfoundland

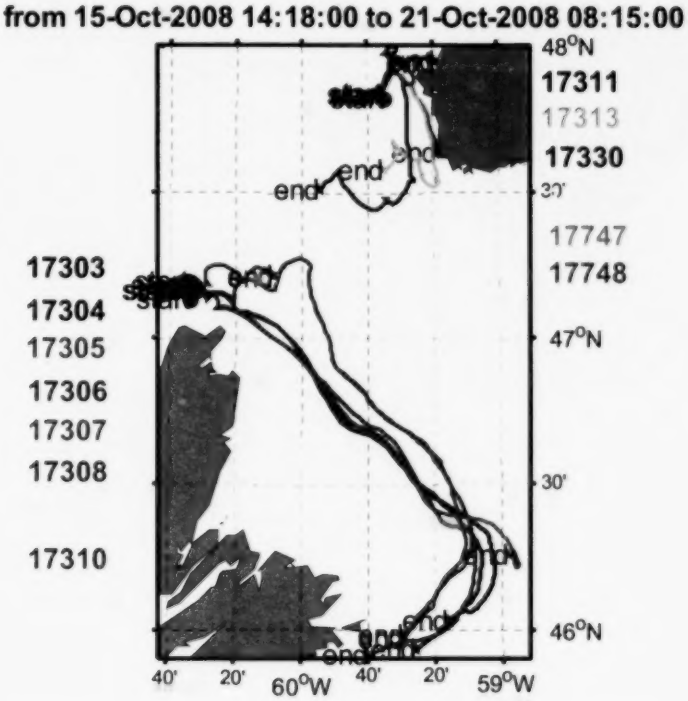

Figure 37 Drift tracks for 2008 coast guard drifters in the Gulf of St. Lawrence; the drifters were released off Cape Breton and off southwestern Newfoundland in Cabot Strait

4.1 2008 drifter time series of positions

4.1.1 MetOcean drifters half-hourly positions

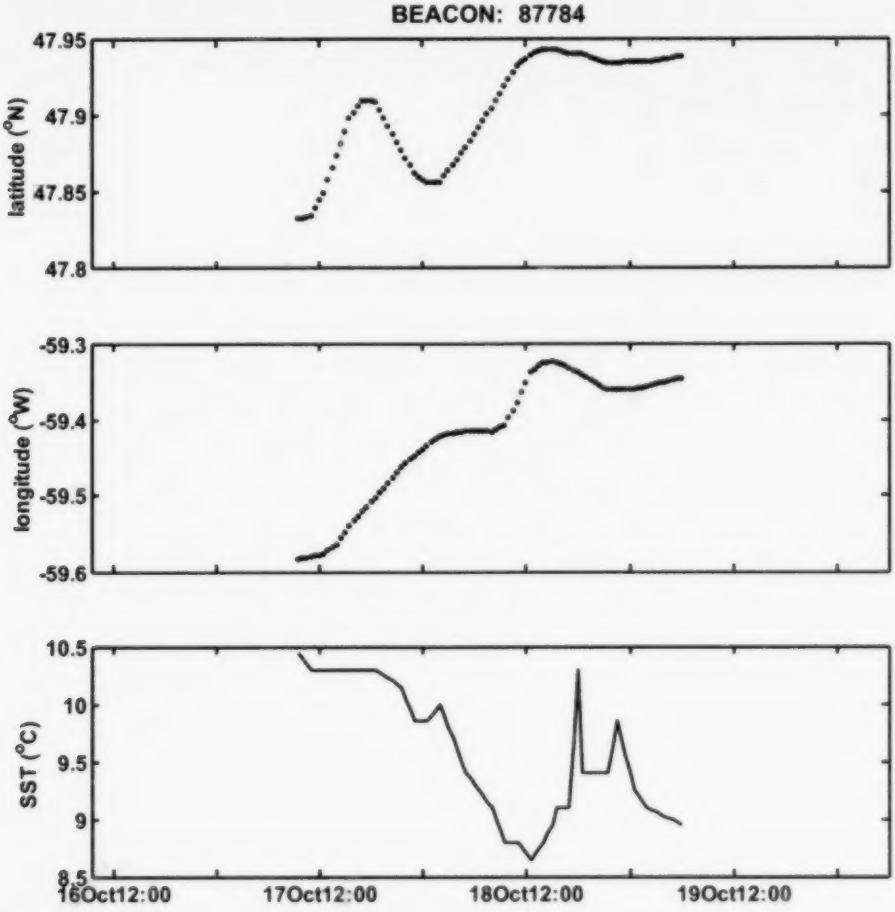

Figure 38 Interpolated half-hourly Position and SST for drifter 87784

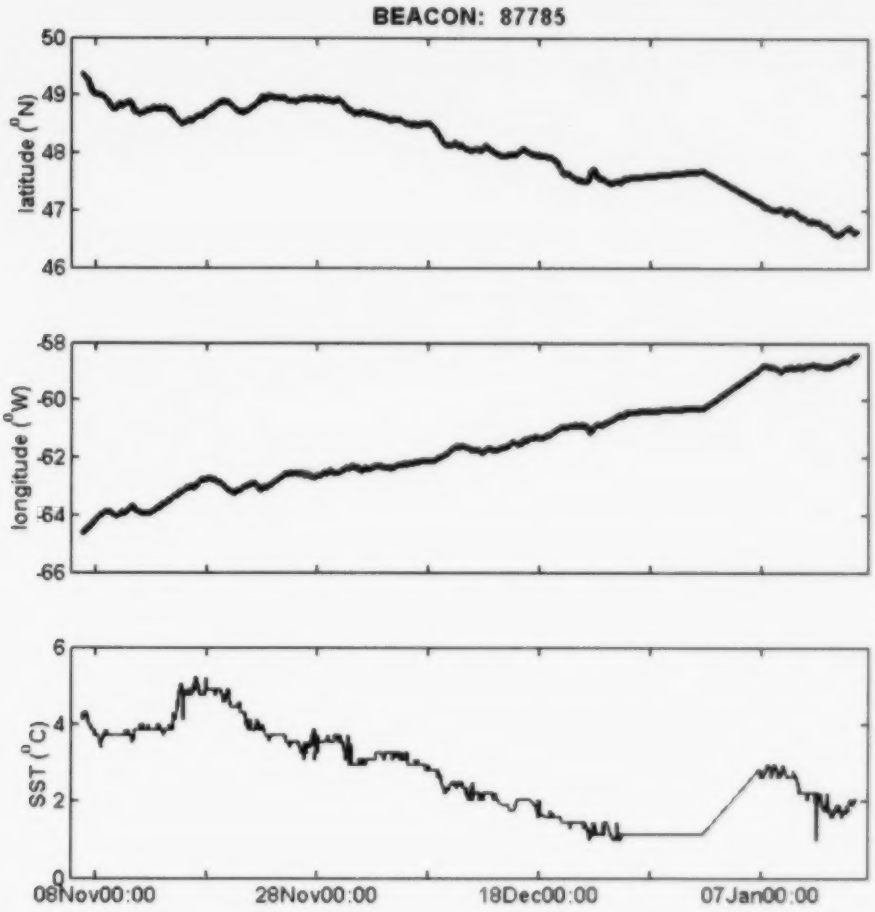

Figure 39 Interpolated half-hourly Position and SST for drifter 87785

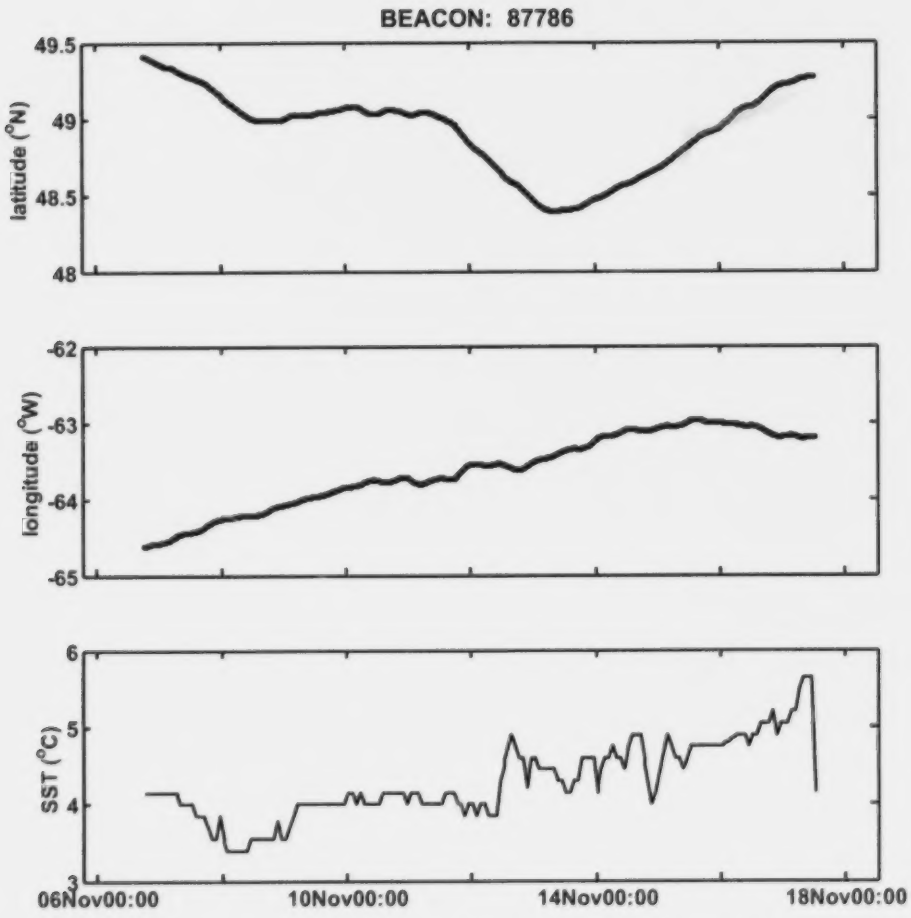

Figure 40 Interpolated half-hourly Position and SST for drifter 87786

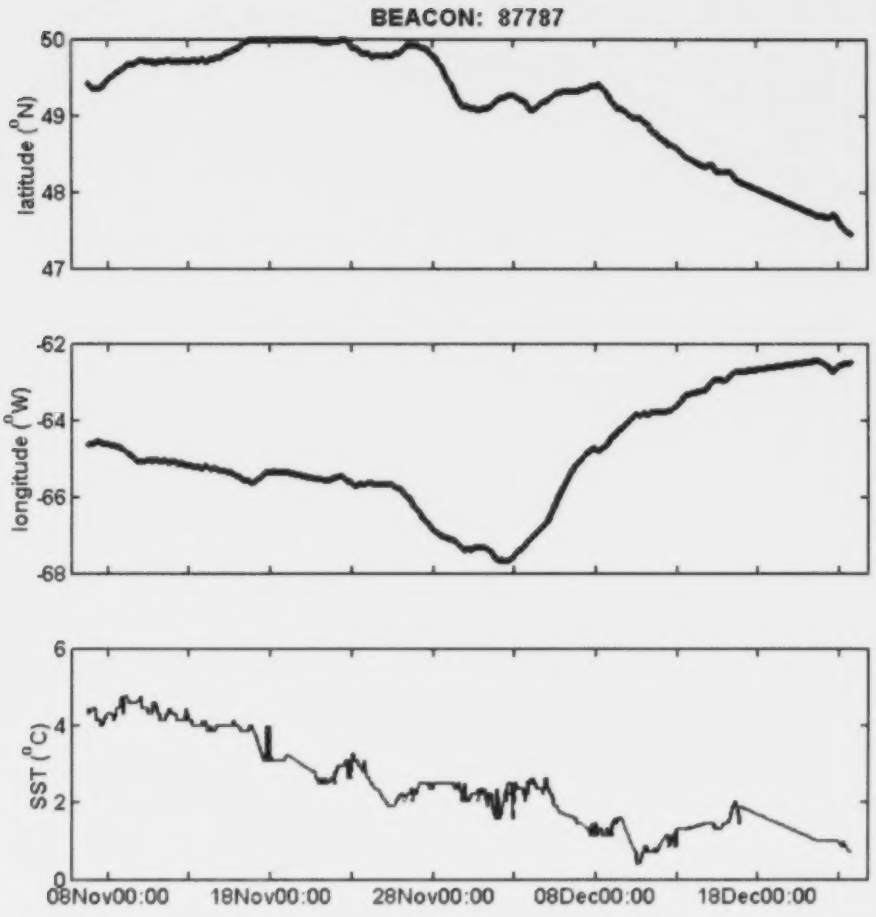

Figure 41 Interpolated half-hourly Position and SST for drifter 87787

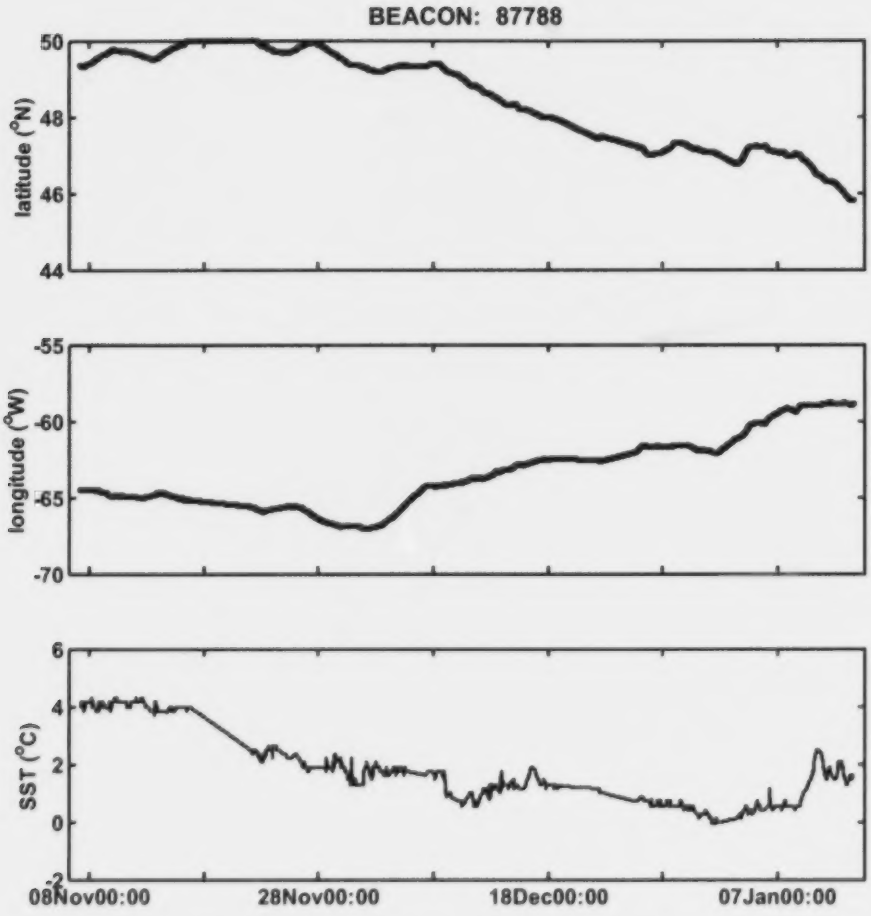

Figure 42 Interpolated half-hourly Position and SST for drifter 87788

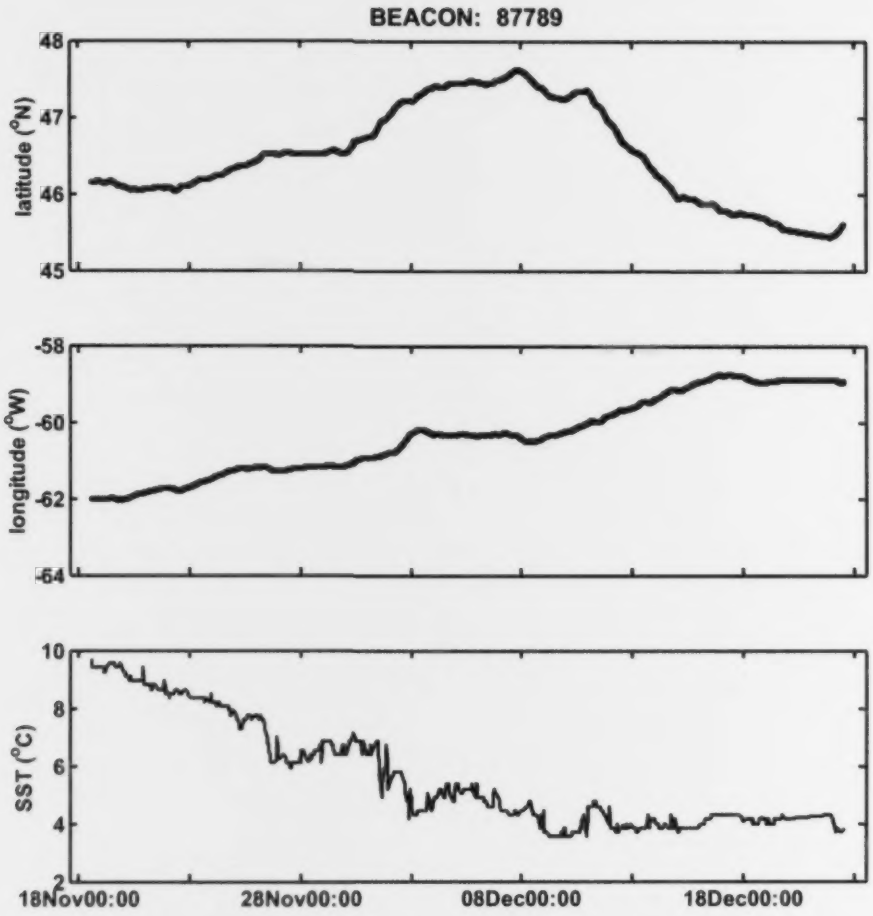

Figure 43 Interpolated half-hourly Position and SST for drifter 87789

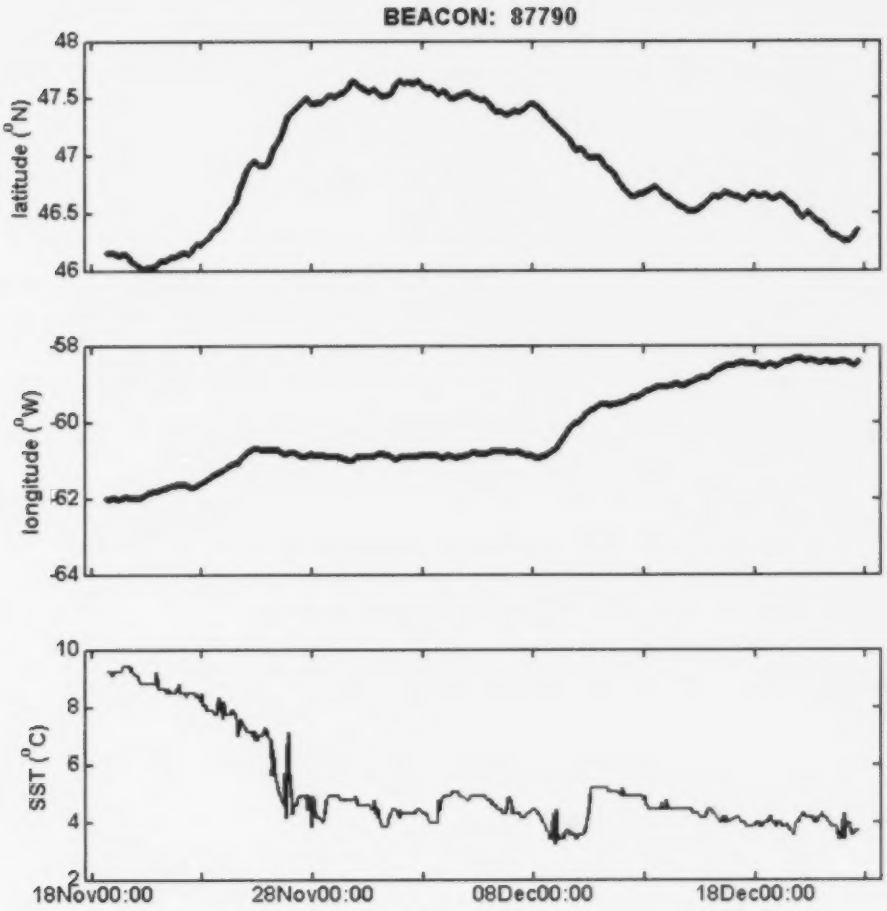

Figure 44 Interpolated half-hourly Position and SST for drifter 87790

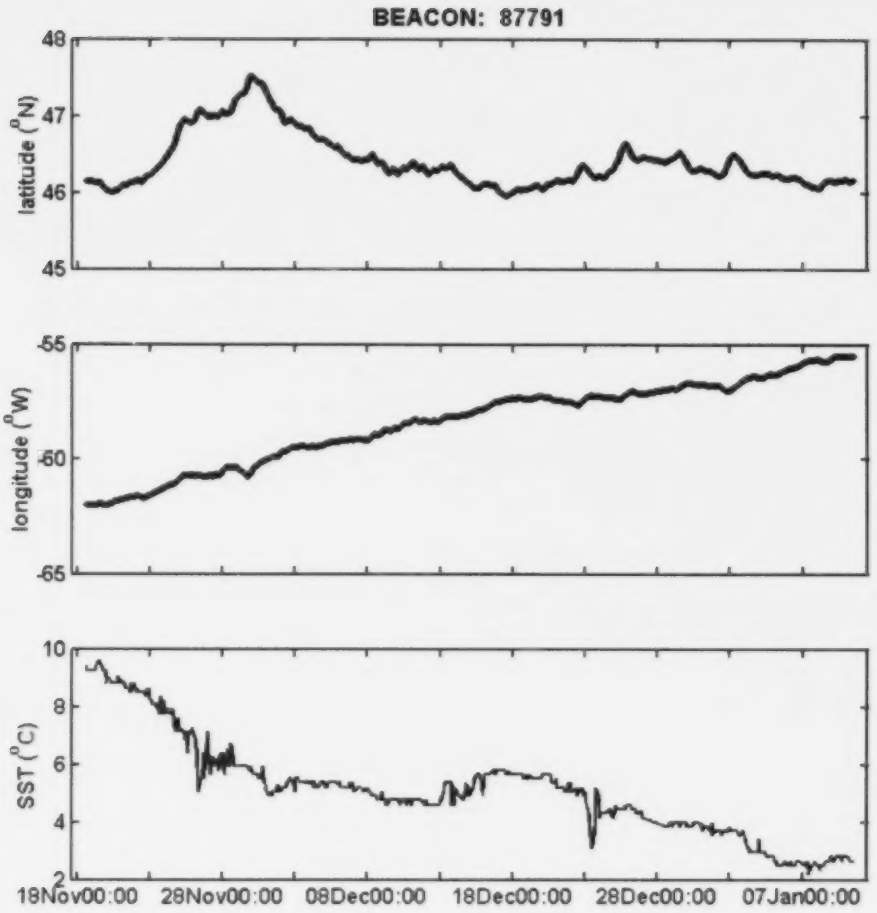

Figure 45 Interpolated half-hourly Position and SST for drifter 87791

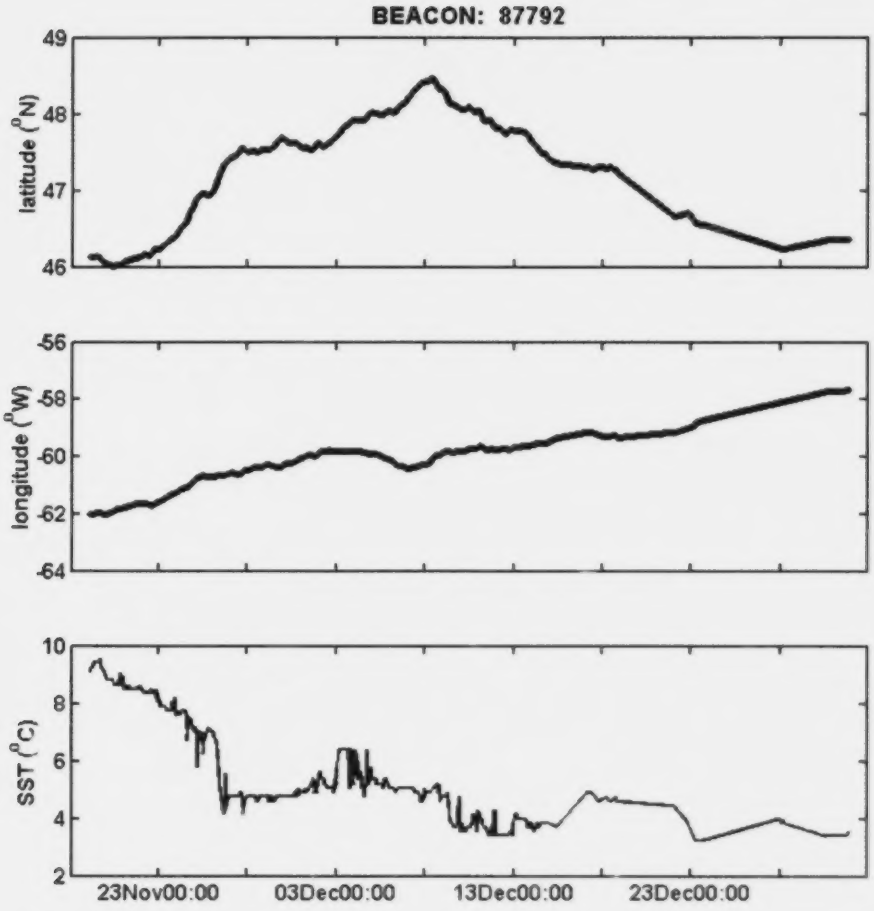

Figure 46 Interpolated half-hourly Position and SST for drifter 87792

4.1.2 Seimac drifter hourly positions

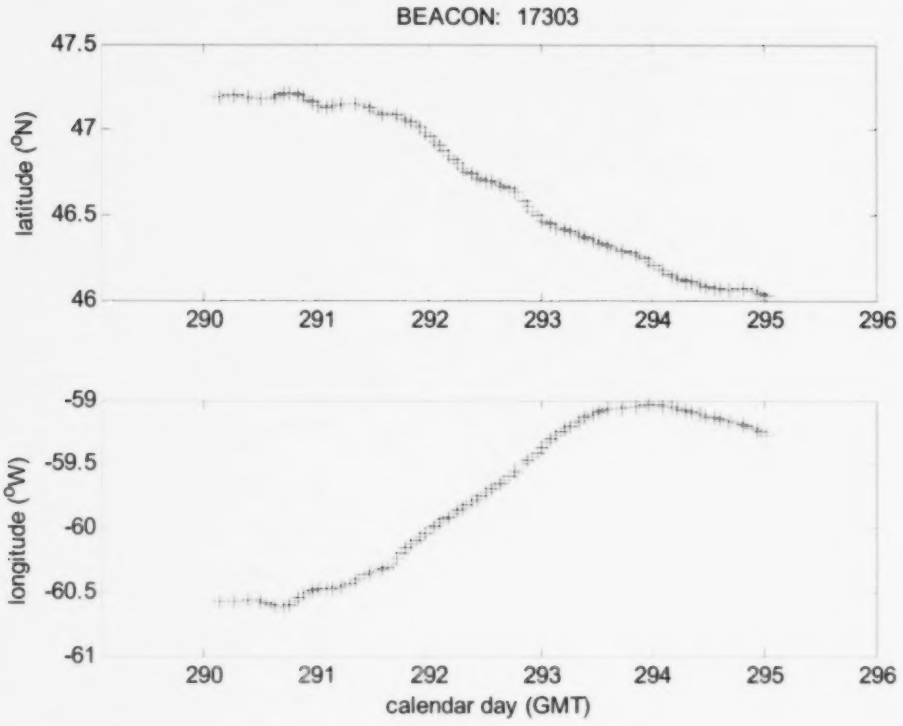

Figure 47 Interpolated hourly data for drifter 17303

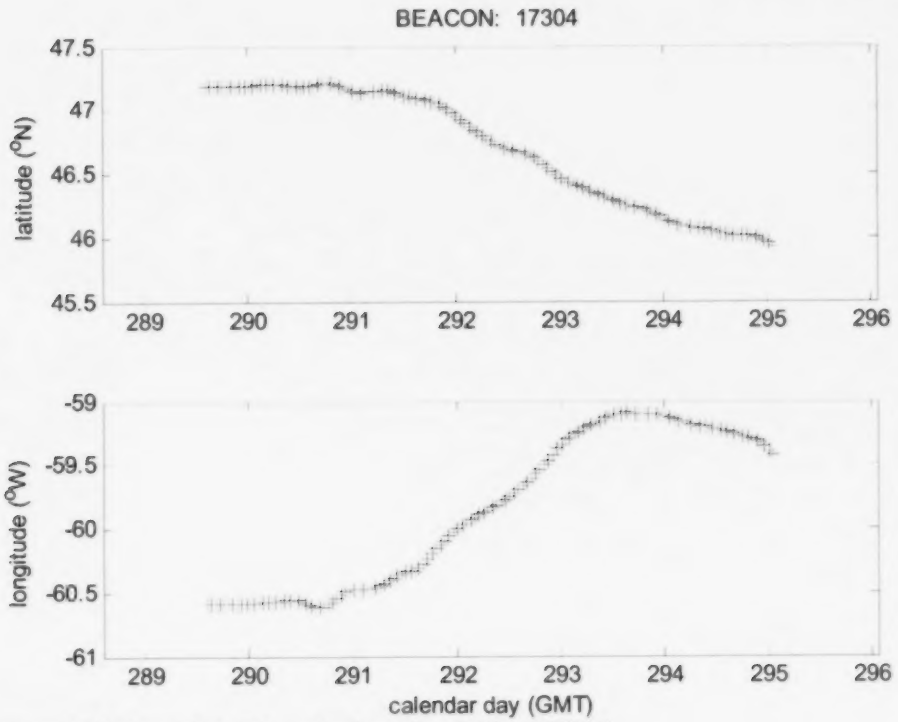

Figure 48 Interpolated hourly data for drifter 17304

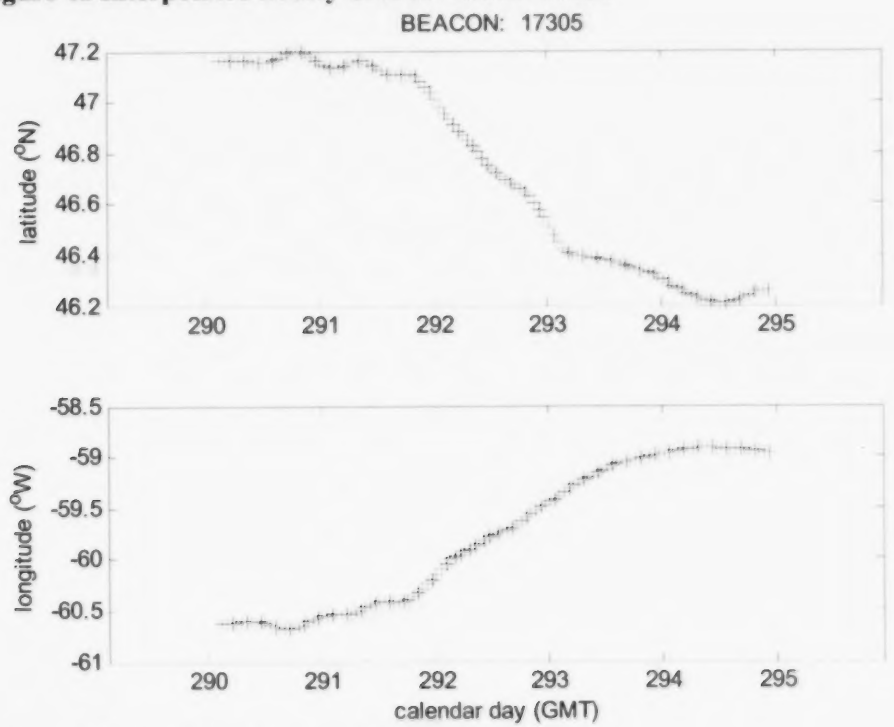

Figure 49 Interpolated hourly data for drifter 17305

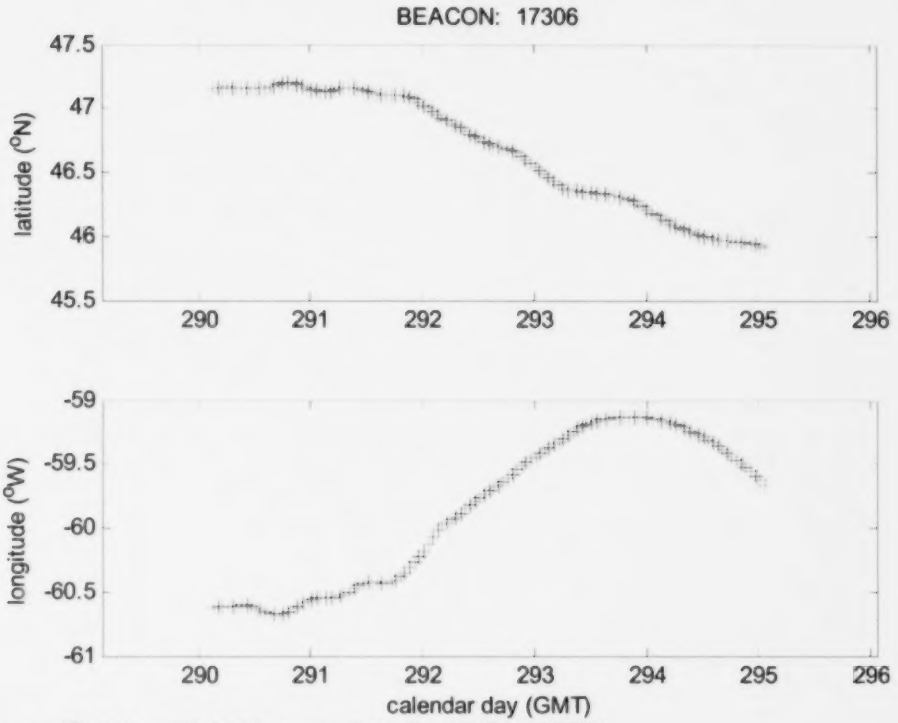

Figure 50 Interpolated hourly data for drifter 17306

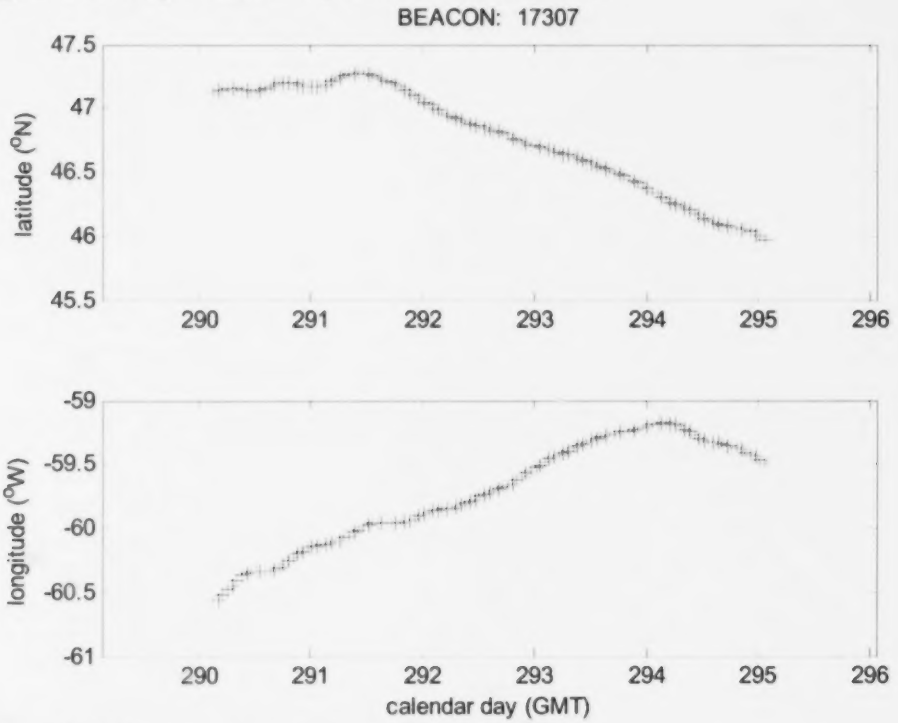

Figure 51 Interpolated hourly data for drifter 17307

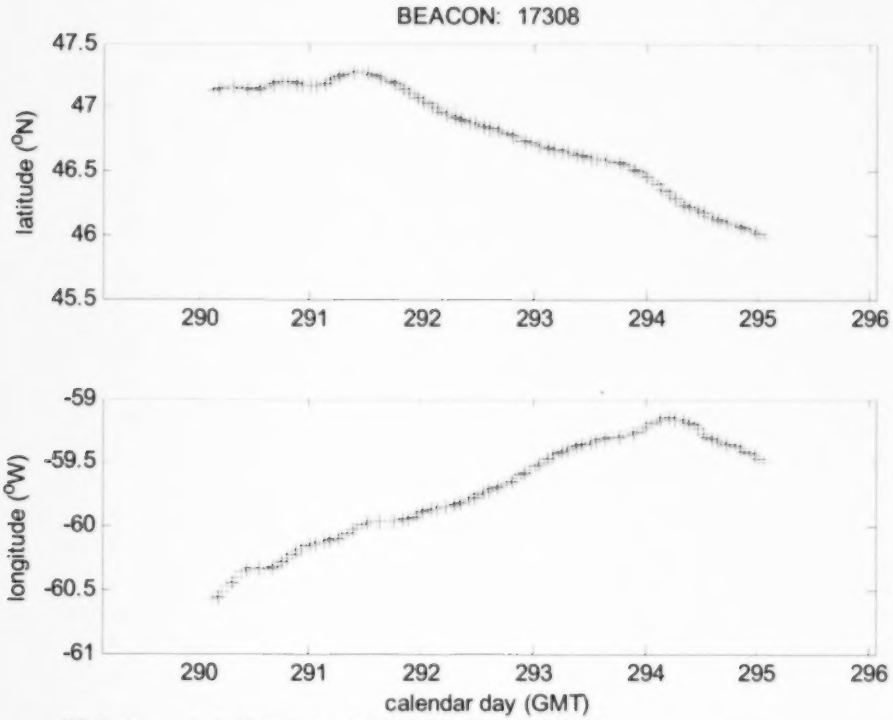

Figure 52 Interpolated hourly data for drifter 17308

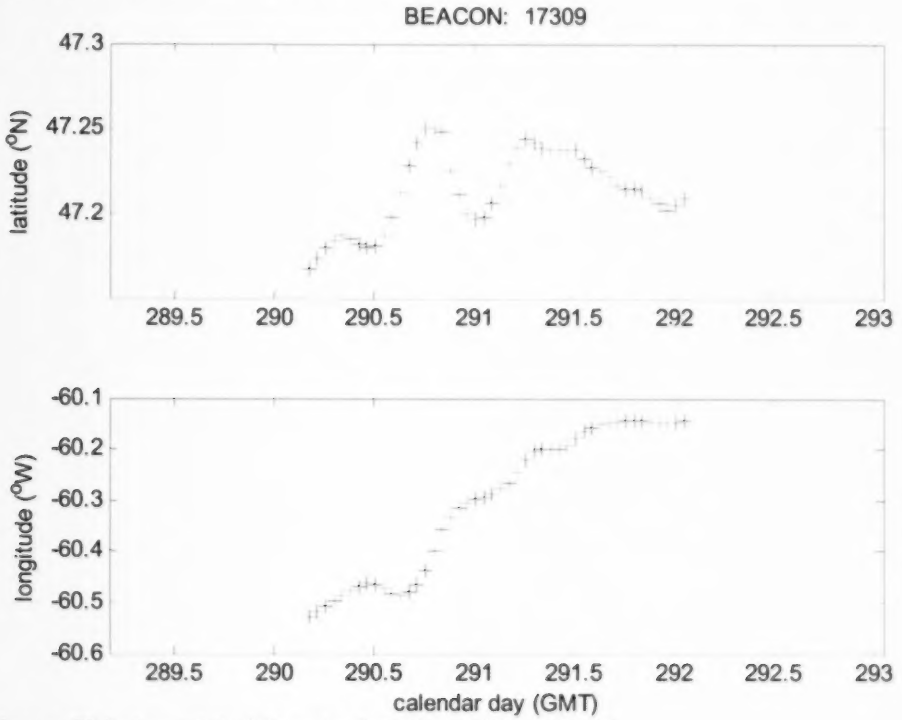

Figure 53 Interpolated hourly data for drifter 17309

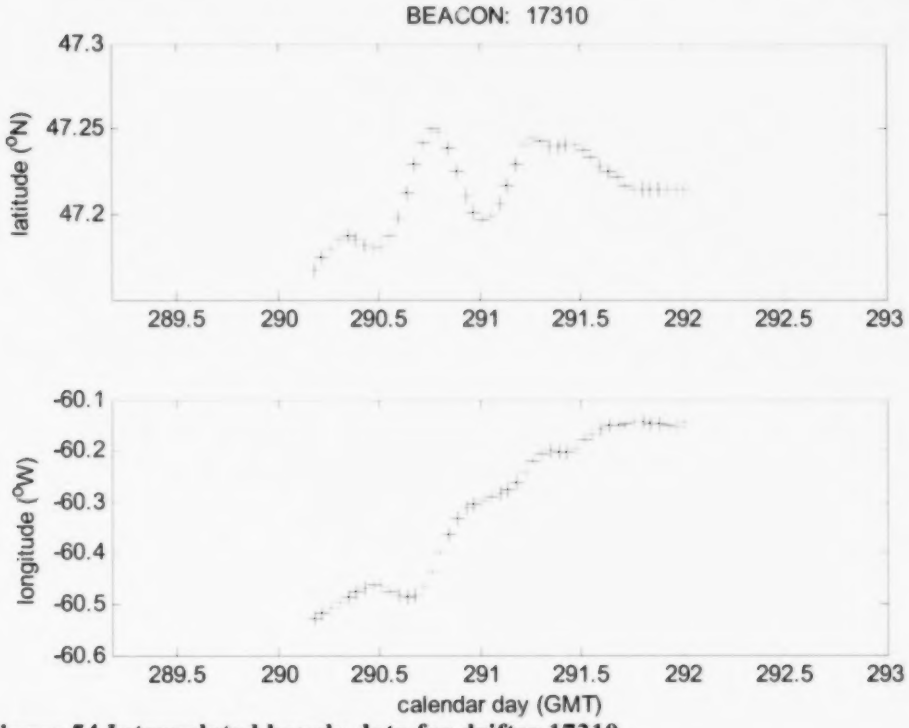

Figure 54 Interpolated hourly data for drifter 17310

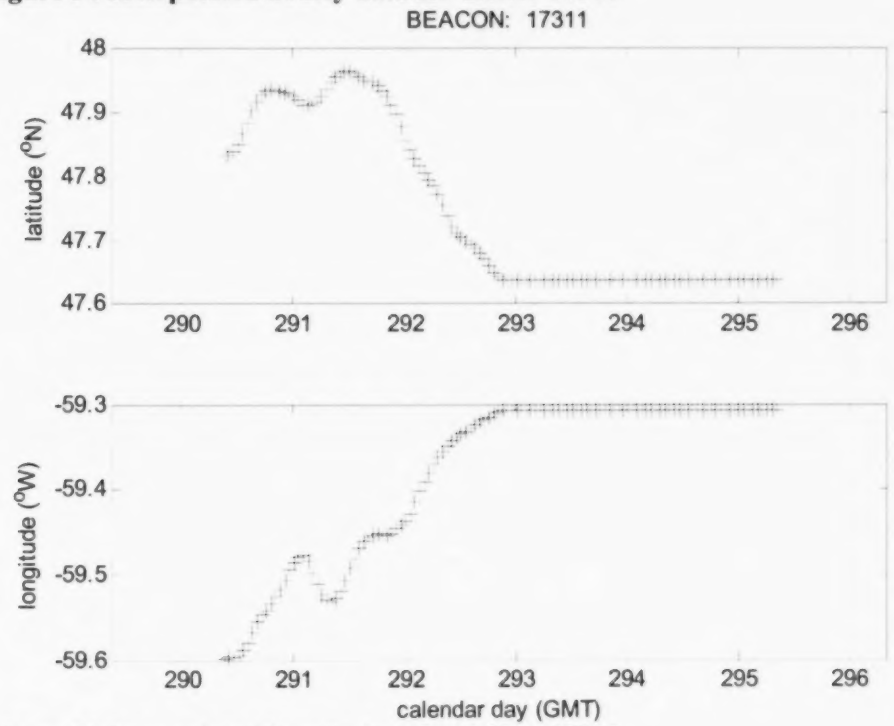

Figure 55 Interpolated hourly data for drifter 17311

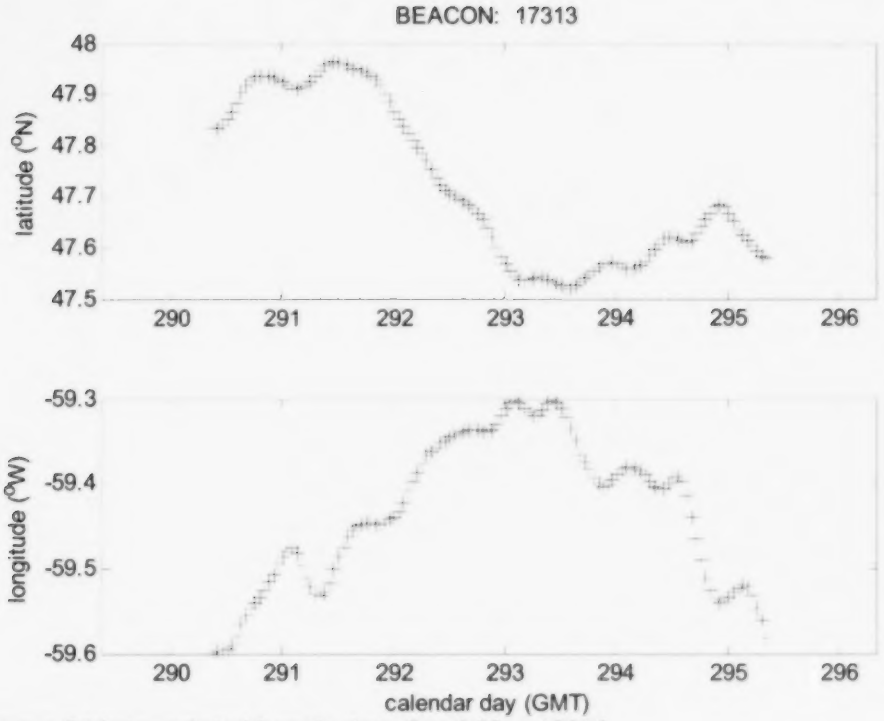

Figure 56 Interpolated hourly data for drifter 17313

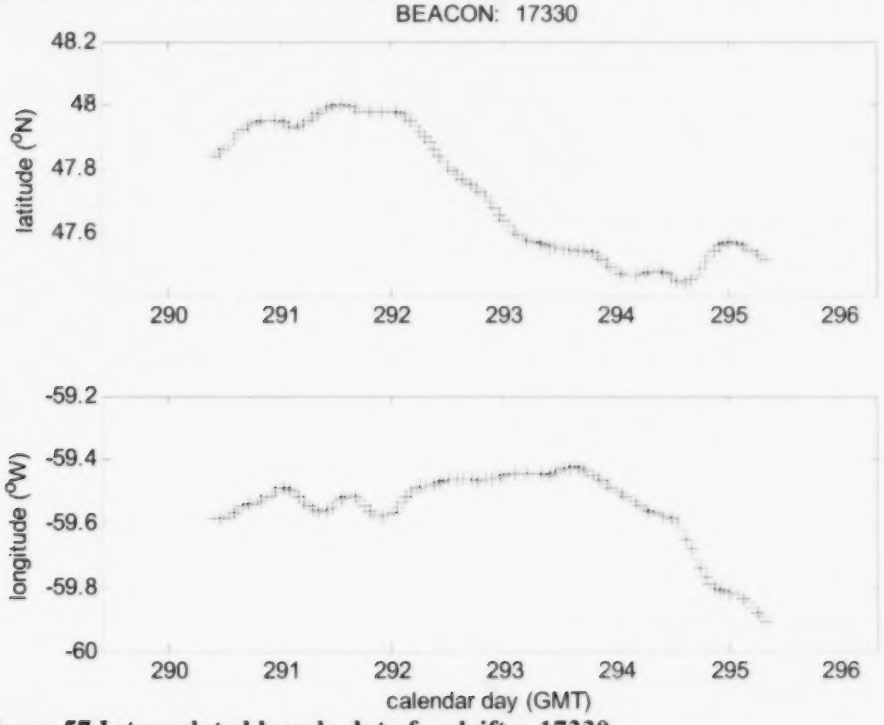

Figure 57 Interpolated hourly data for drifter 17330

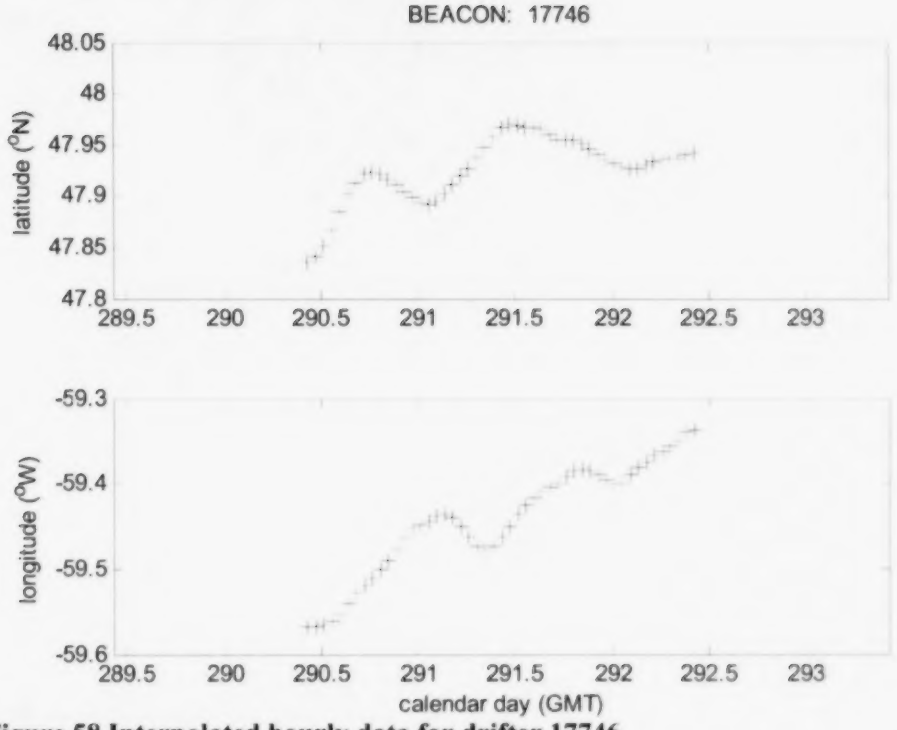

Figure 58 Interpolated hourly data for drifter 17746

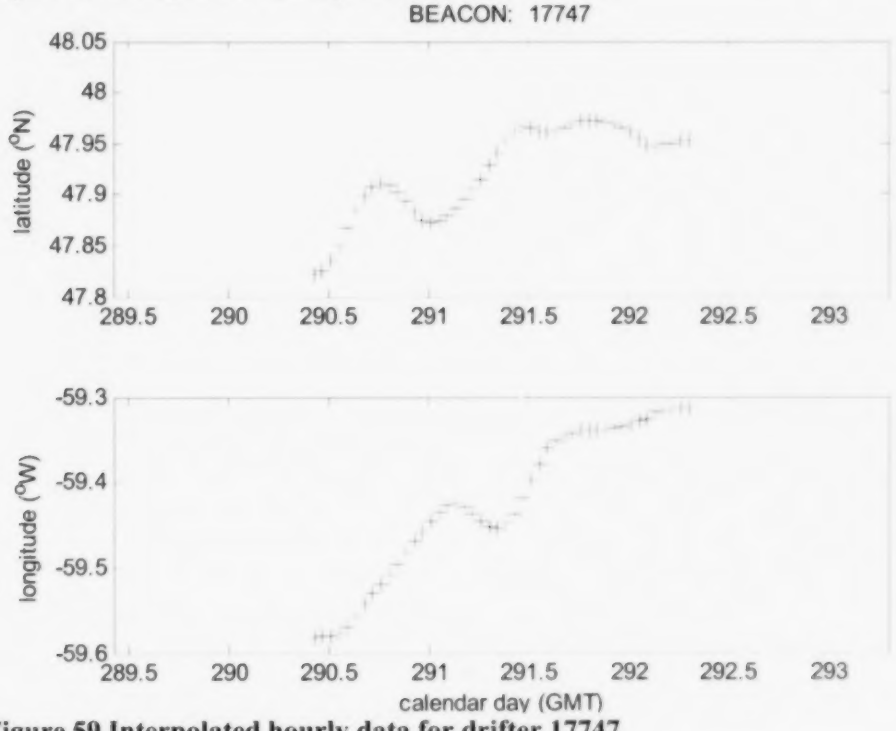

Figure 59 Interpolated hourly data for drifter 17747

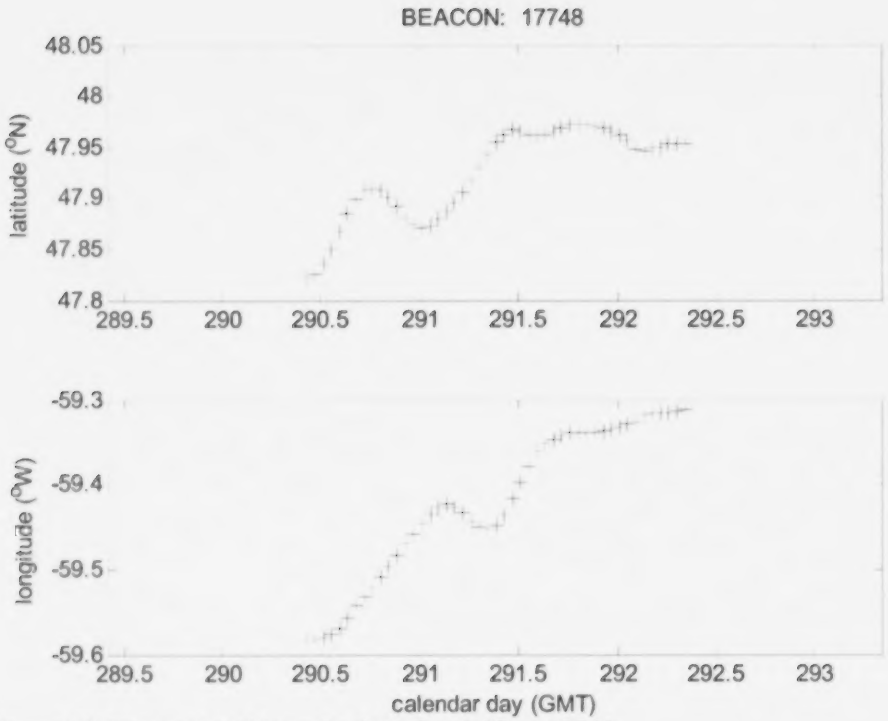

Figure 60 Interpolated hourly data for drifter 17748

4.2 2008 drifter drift

Drifters 87784, 17309, 17310, 17746, 17747, and 17748 were not used due to the brevity of their time series. Basic statistics for 3-hourly drift speeds are given in Table 7. Statistics of drift speed were computed for components computed using the polynomial fit method. Data are lost at the beginning and the end of the complete drift record, depending on the size of the sampling interval and the statistics for drifter drift will reflect this. Table 8 gives the minimum, maximum, and mean of the measured sea surface temperature from the MetOcean drifters.

Table 7 Basic statistics for 3-hourly drift velocity

ID	total dist (km)	min U (m/s)	max U (m/s)	mean U (m/s)	min V (m/s)	max V (m/s)	mean V (m/s)
87784	36.8232	-0.1525	0.5453	0.1281	-0.2544	0.3875	0.0545
87785	1437.3997	-0.7830	0.7474	0.0891	-0.5749	0.7611	-0.0392
87786	327.9035	-0.4965	0.8373	0.1329	-0.5104	0.4285	-0.0122
87787	1106.8448	-1.0661	1.0840	0.0452	-0.6116	0.2980	-0.0413
87788	1794.2989	-0.7485	1.2534	0.0844	-0.5553	0.7262	-0.0525
87789	767.0502	-0.4243	0.8434	0.0894	-0.6937	0.5499	-0.0159
87790	831.1325	-0.4048	0.9535	0.1052	-0.3980	0.6688	0.0059
87791	1403.7189	-0.6204	1.1607	0.1232	-0.6040	0.6895	0.0008
87792	986.5670	-0.7644	1.0790	0.1023	-0.6559	0.6924	0.0047
17303	211.9306	-0.3218	0.9647	0.2645	-0.7333	0.1948	-0.2295
17304	217.1744	-0.8468	0.9665	0.2125	-0.7420	0.2011	-0.2313
17305	204.1913	-0.3156	1.2652	0.3552	-0.7778	0.2428	-0.1900
17306	240.5481	-0.7727	1.3329	0.2143	-0.7012	0.2336	-0.2517
17307	228.9537	-0.5859	0.9574	0.2309	-0.6070	0.4942	-0.2330
17308	230.7255	-0.6553	0.9580	0.2311	-0.6887	0.4974	-0.2292
17309	43.4113	-0.1612	0.8014	0.2137	-0.3014	0.3132	0.0218
17310	42.3009	-0.1547	0.8189	0.2173	-0.2825	0.3058	0.0261
17311	67.1189	-0.3284	0.2718	0.0577	-0.4230	0.4130	-0.0392
17313	125.4676	-0.5923	0.3066	0.0010	-0.4521	0.4103	-0.0527
17330	138.5772	-0.7014	0.3924	-0.0602	-0.4569	0.4438	-0.0627
17746	40.4918	-0.2844	0.3289	0.1179	-0.1445	0.4180	0.0555
17747	40.5954	-0.2160	0.4656	0.1452	-0.1807	0.4204	0.0690
17748	40.8006	-0.2050	0.4680	0.1433	-0.1812	0.4129	0.0688

Table 8 Basic statistics for sea surface temperature measured by 2008 MetOcean drifters

ID	min SST	max SST	mean SST
87784	8.6500	10.4500	9.5800
87785	1.0000	5.2000	2.6944
87786	3.4000	5.6500	4.2879
87787	0.4000	4.7500	2.4131
87788	-0.0500	4.3000	1.7871
87789	3.5500	9.7000	5.6293
87790	3.2500	9.4000	5.2295
87791	2.2000	9.5500	5.1076
87792	3.2500	9.5500	4.9745

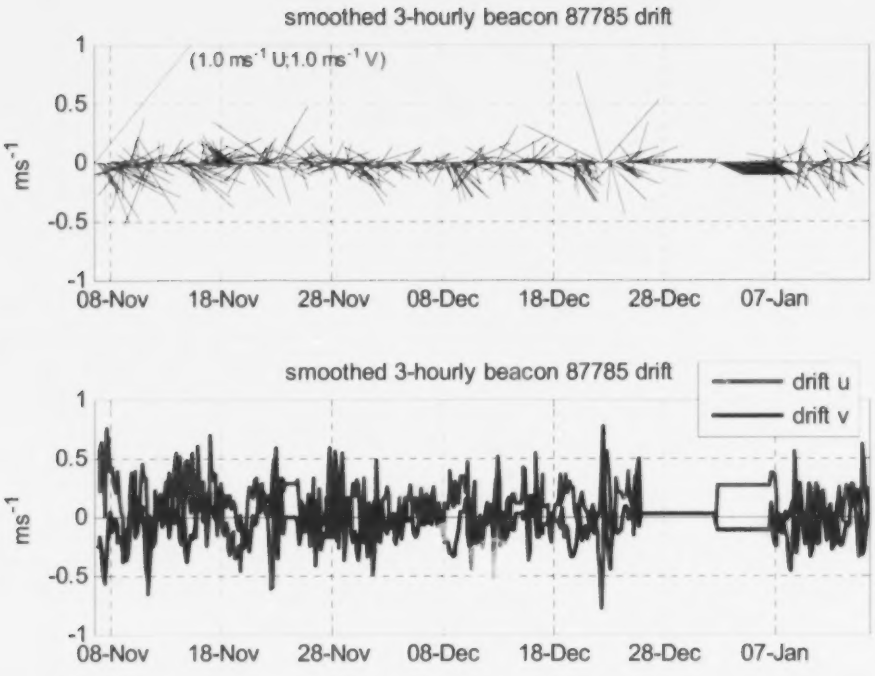

Figure 61 3-hourly drift data for drifter 87785; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

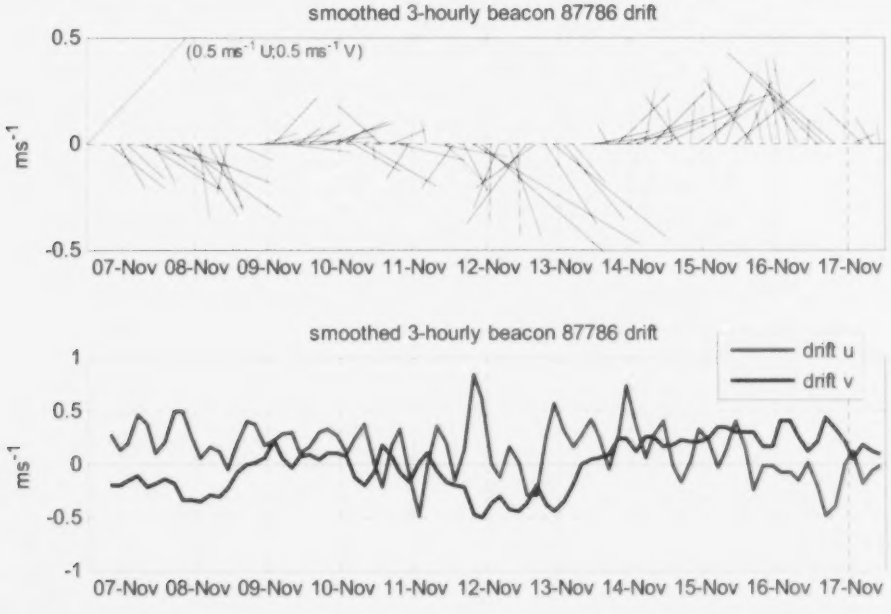

Figure 62 3-hourly drift data for drifter 87786; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

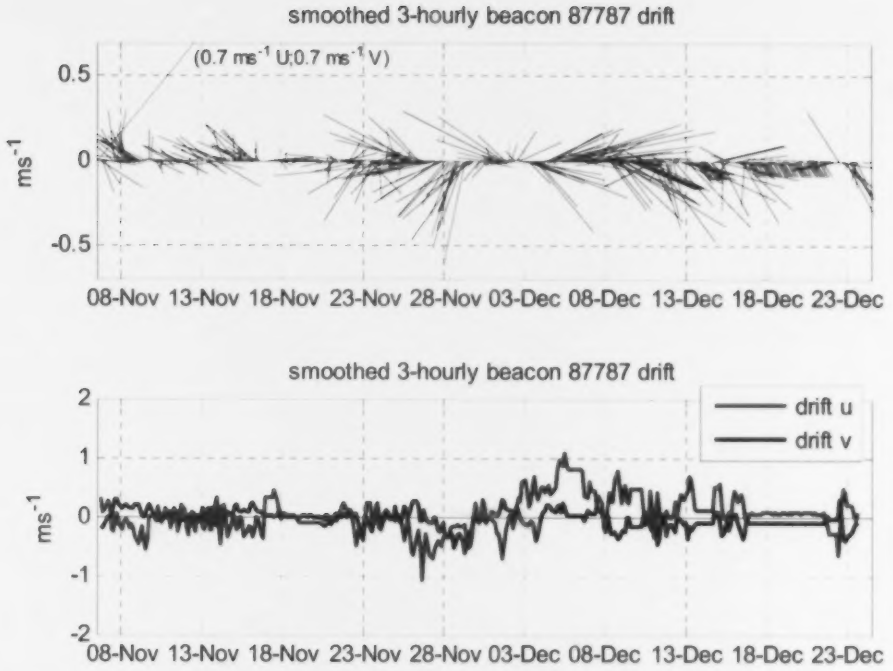

Figure 63 3-hourly drift data for drifter 87787; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

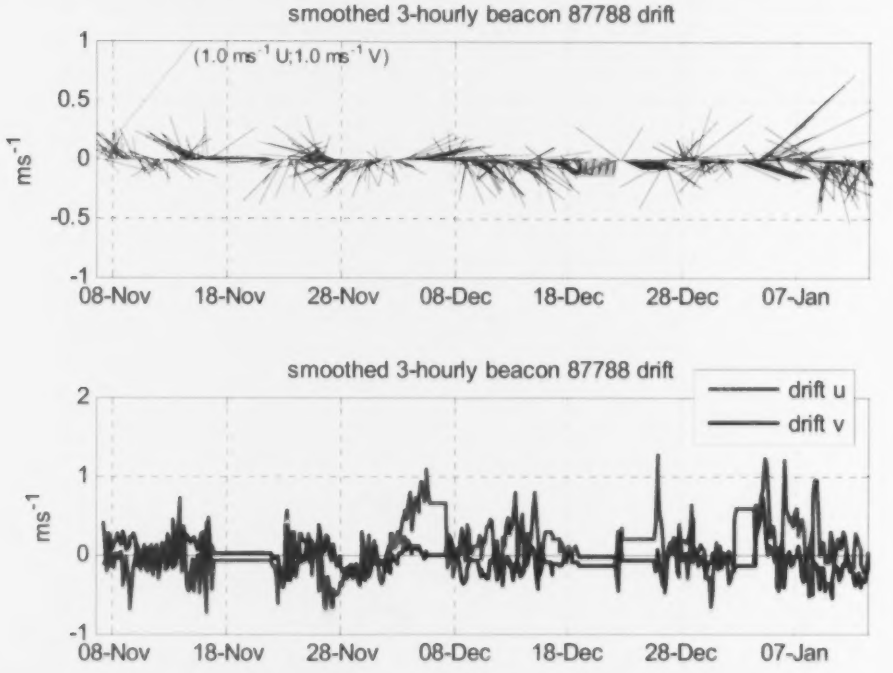

Figure 64 3-hourly drift data for drifter 87787; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

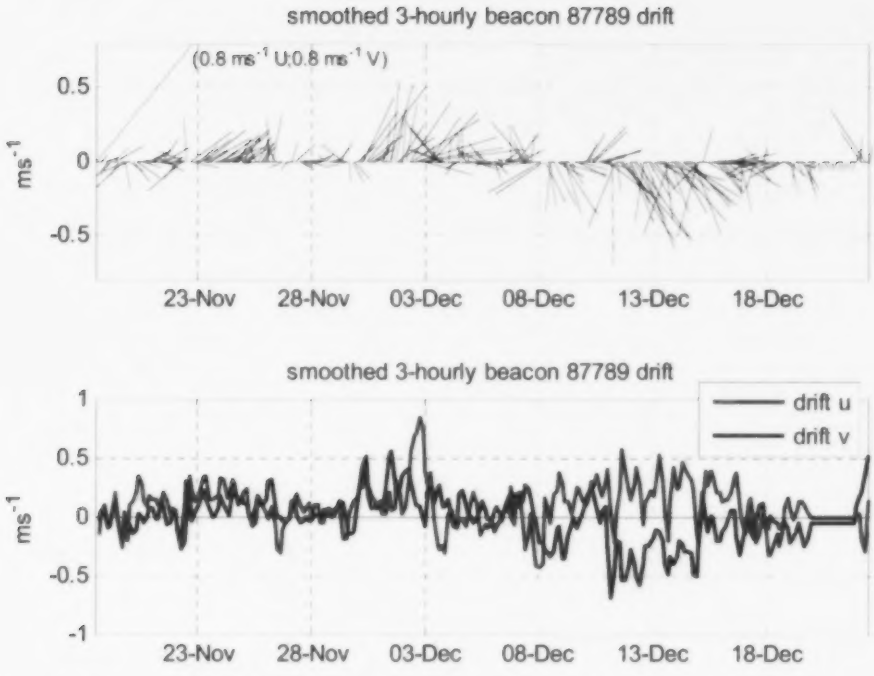

Figure 65 3-hourly drift data for drifter 87788; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

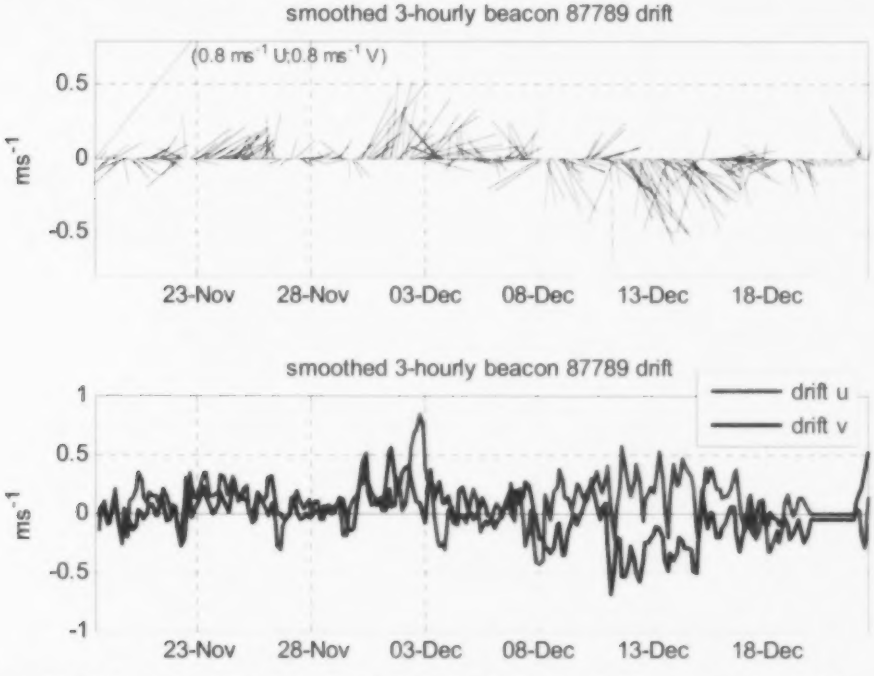

Figure 66 3-hourly drift data for drifter 87789; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

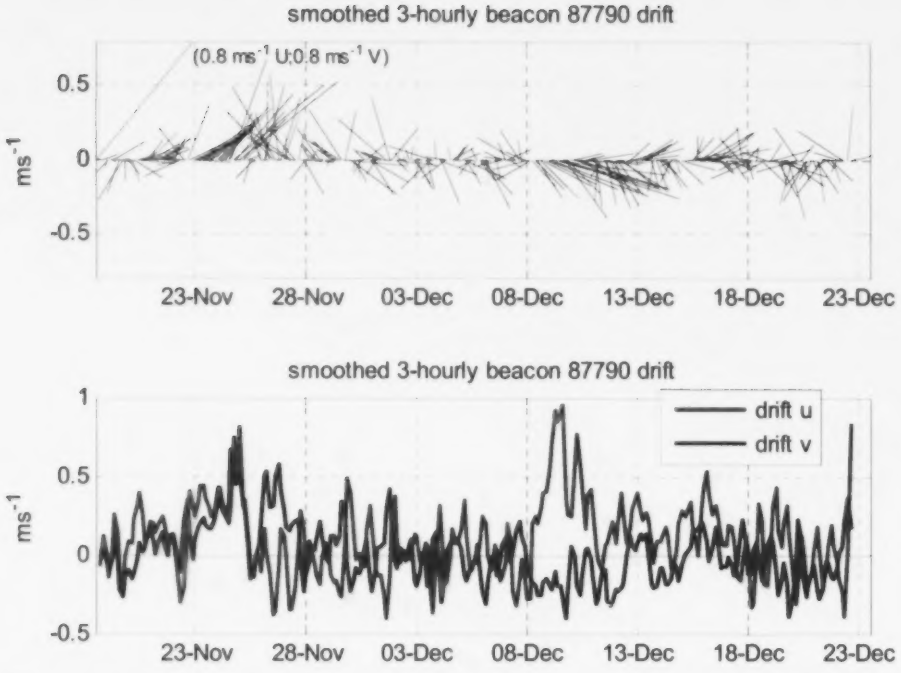

Figure 67 3-hourly drift data for drifter 87790; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

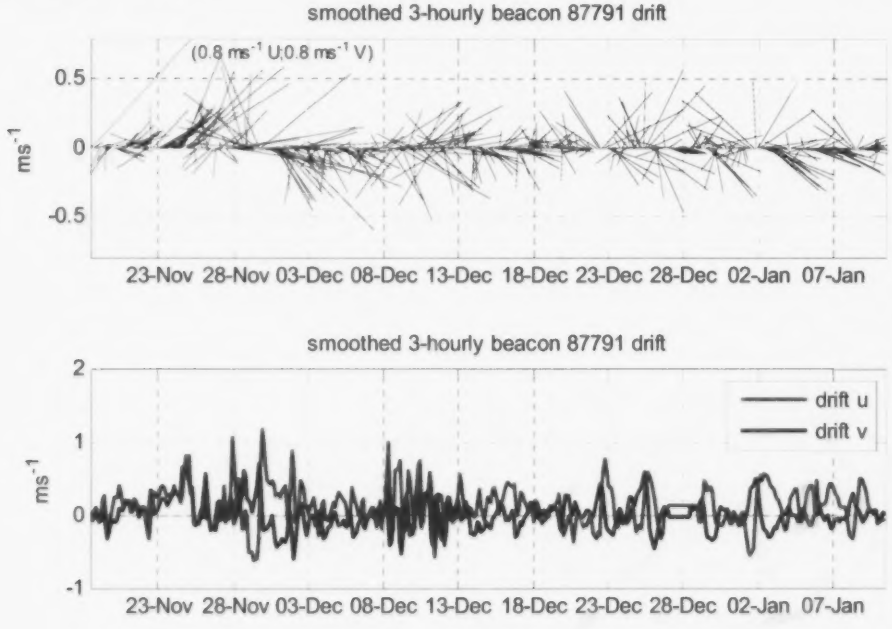

Figure 68 3-hourly drift data for drifter 87791; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

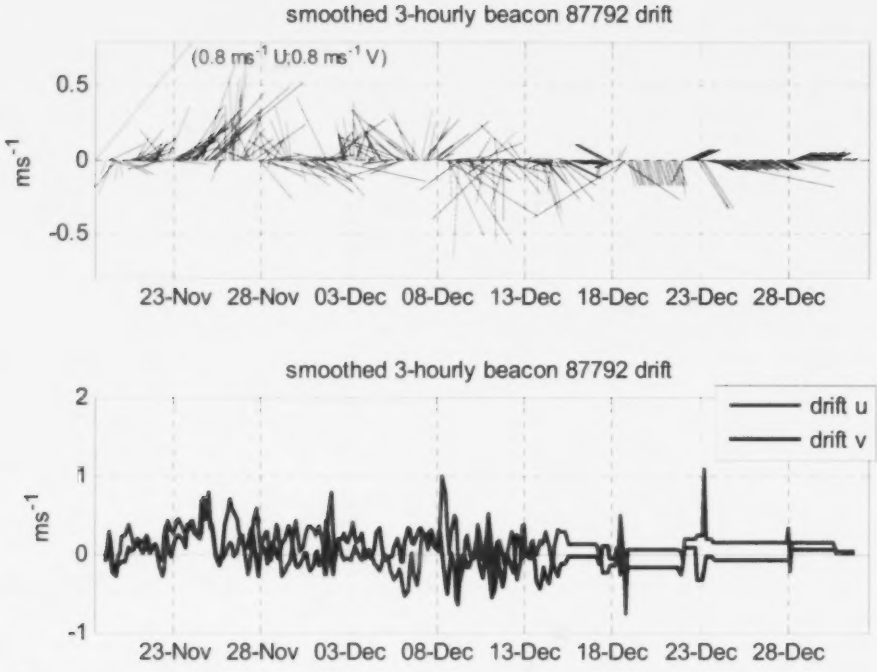

Figure 69 3-hourly drift data for drifter 87792; the drift was computed by smoothing with a polynomial fit using a 3 hour window; plot ticks are at 00:00

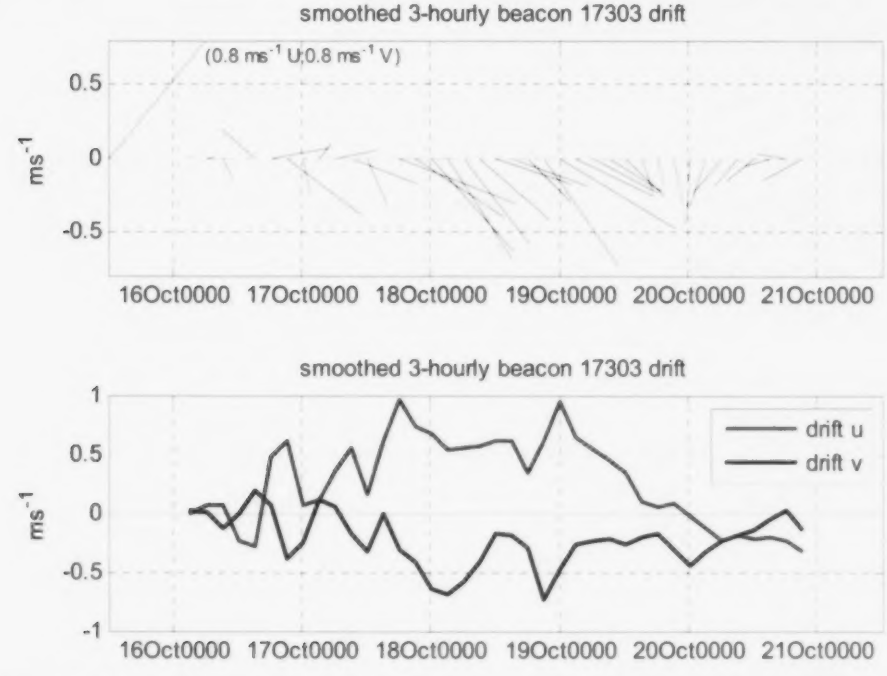

Figure 70 3-hourly drift data for drifter 17303; the drift was computed by smoothing with a polynomial fit using a 3 hour window

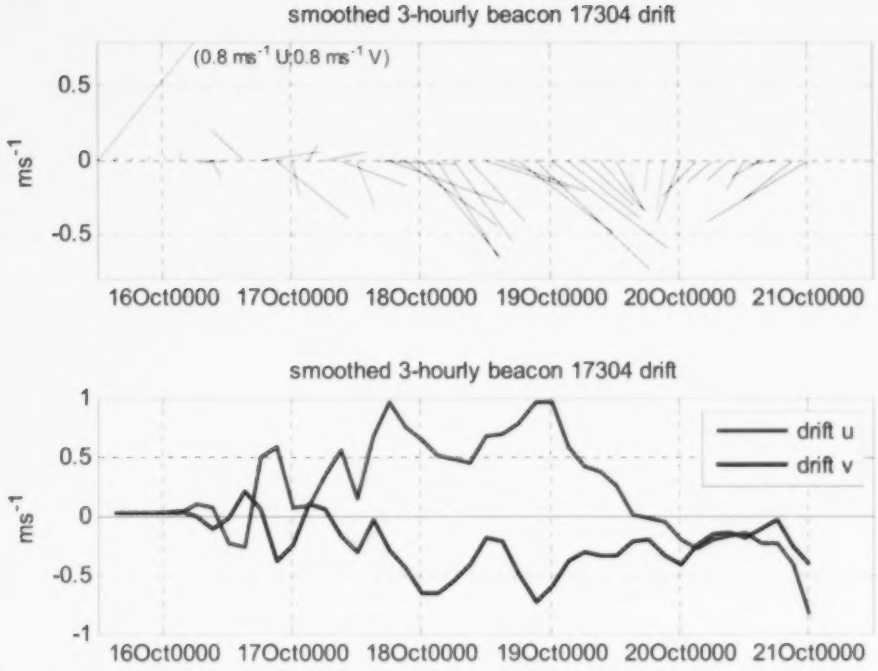

Figure 71 3-hourly drift data for drifter 17304; the drift was computed by smoothing with a polynomial fit using a 3 hour window

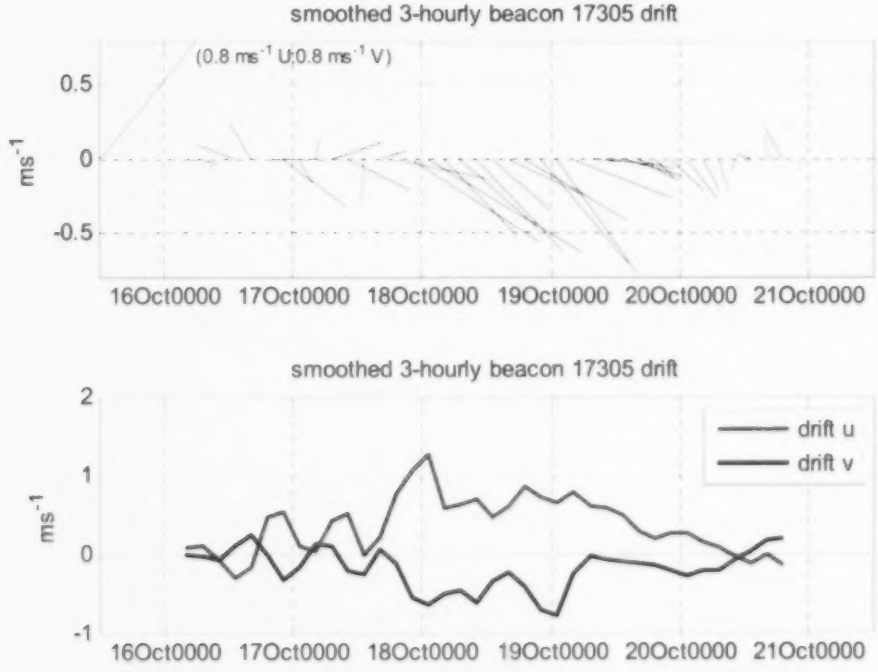

Figure 72 3-hourly drift data for drifter 17305; the drift was computed by smoothing with a polynomial fit using a 3 hour window

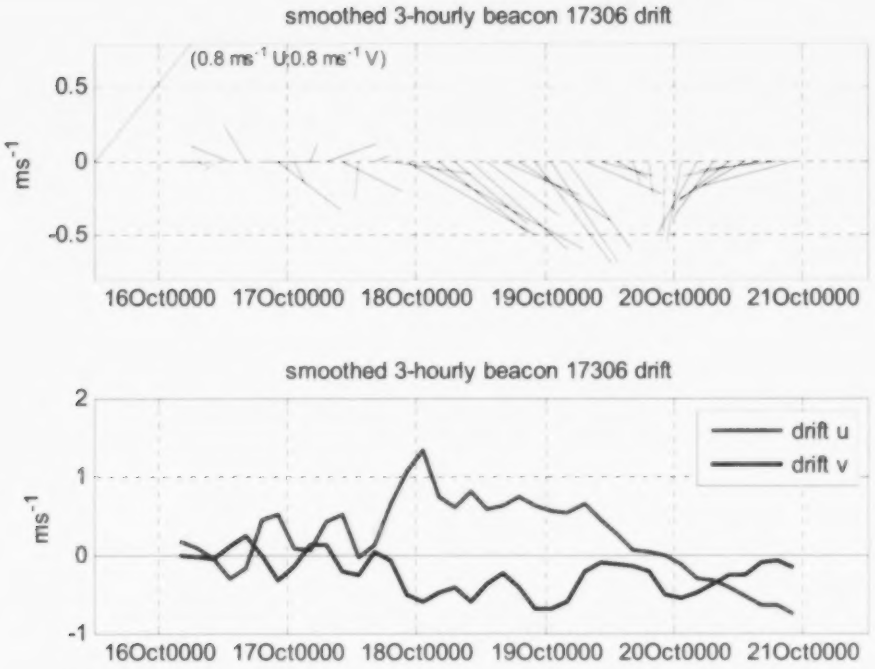

Figure 73 3-hourly drift data for drifter 17306; the drift was computed by smoothing with a polynomial fit using a 3 hour window

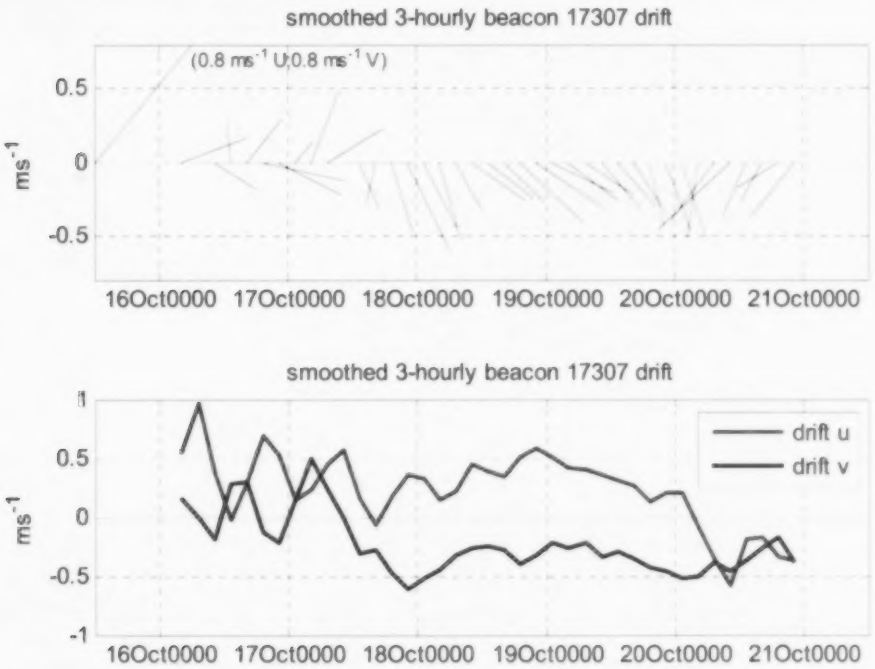

Figure 74 3-hourly drift data for drifter 17307; the drift was computed by smoothing with a polynomial fit using a 3 hour window

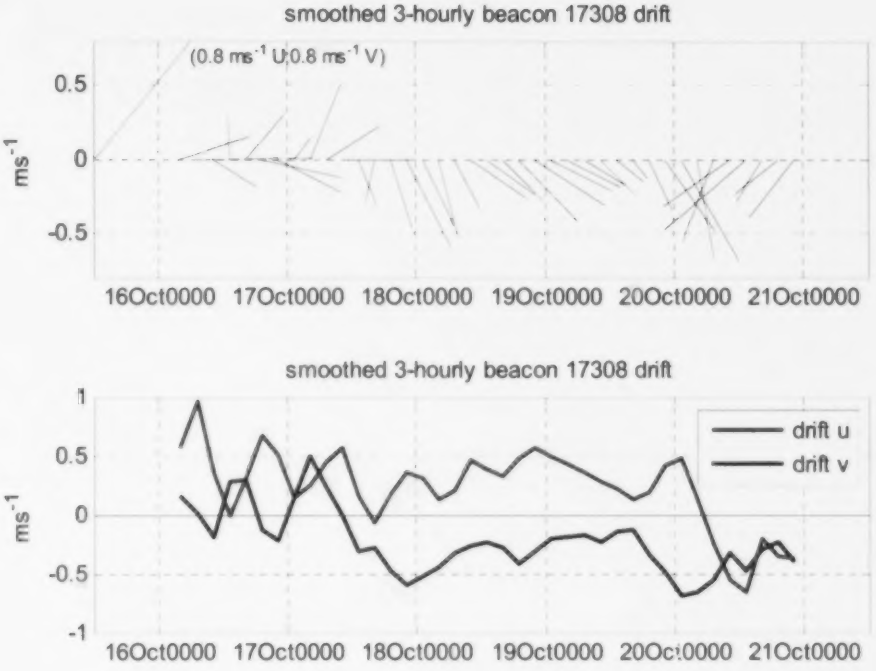

Figure 75 3-hourly drift data for drifter 17308; the drift was computed by smoothing with a polynomial fit using a 3 hour window

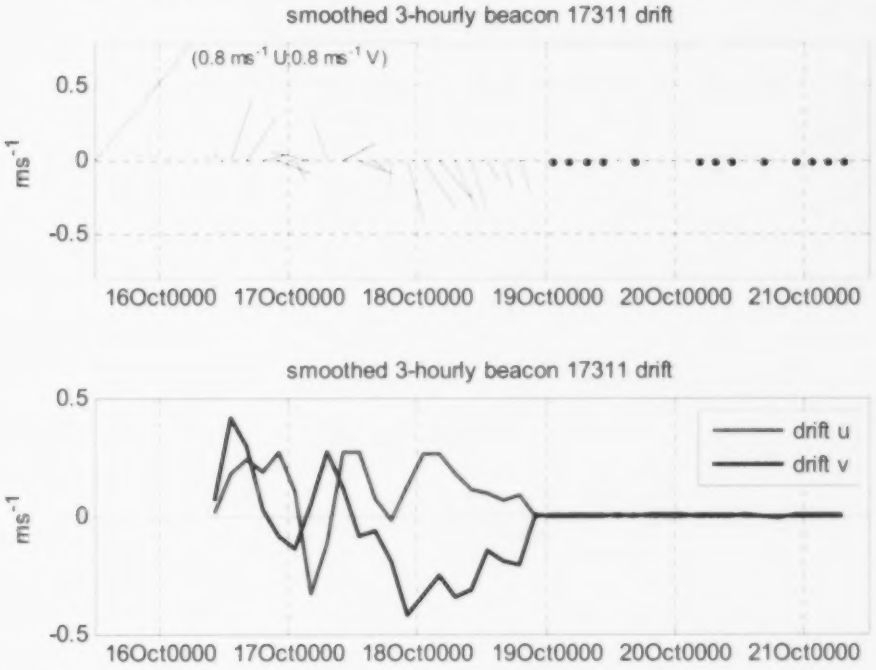

Figure 76 3-hourly drift data for drifter 17311; the drift was computed by smoothing with a polynomial fit using a 3 hour window

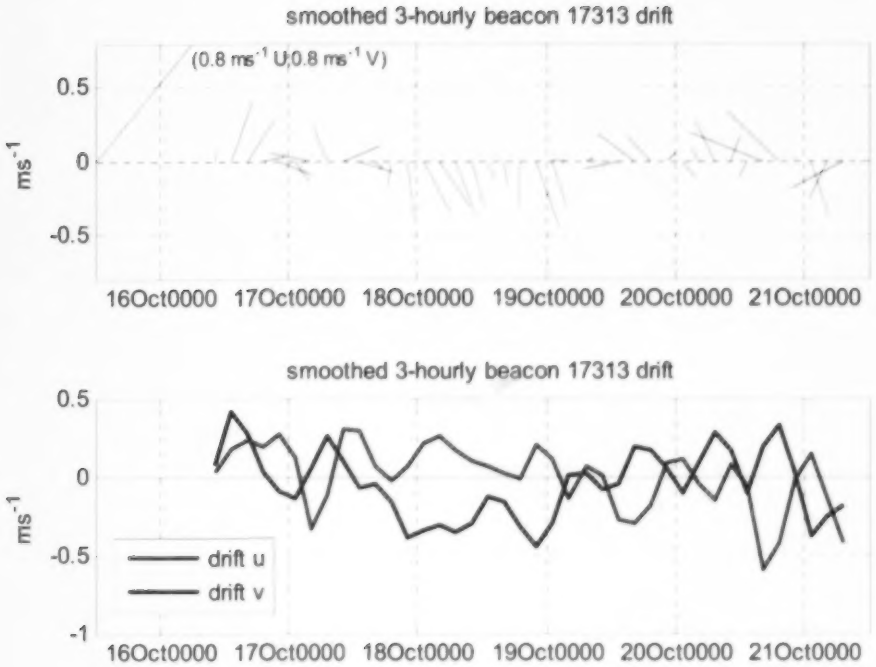

Figure 77 3-hourly drift data for drifter 17313; the drift was computed by smoothing with a polynomial fit using a 3 hour window

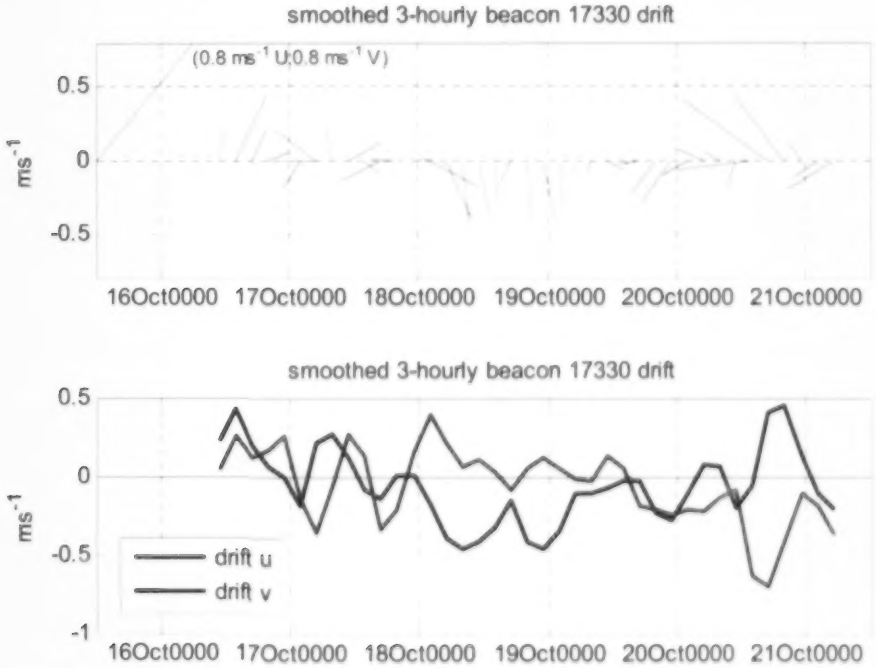

Figure 78 3-hourly drift data for drifter 17330; the drift was computed by smoothing with a polynomial fit using a 3 hour window

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6 Appendix 1: Individual drifter drift tracks for 2007

Individual drifter drift tracks show the trace of the entire time series where each dot depicts every 6th point in the series (every 3rd hour for the MetOcean drifters and every 6th hour for the Seimac drifters).

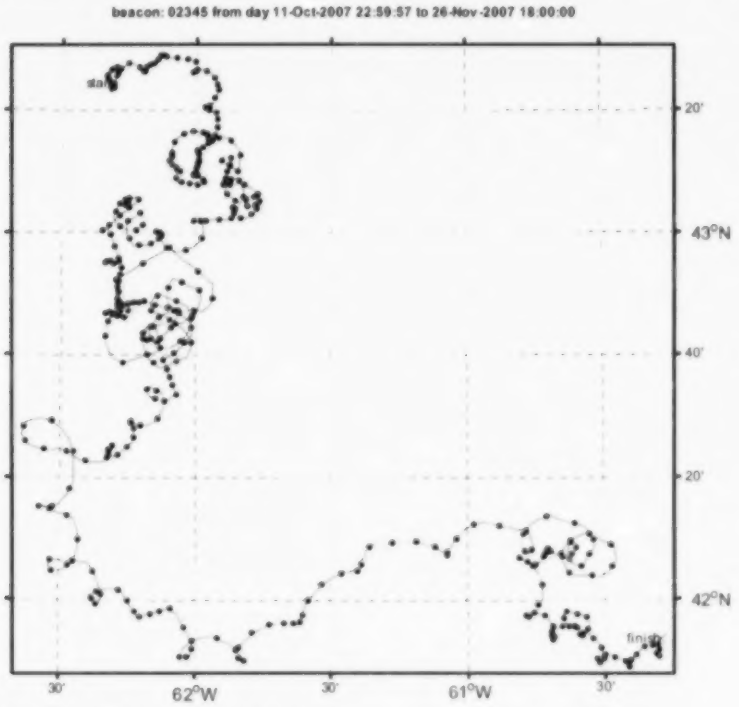

Figure 79 Drift track for drifter 02345

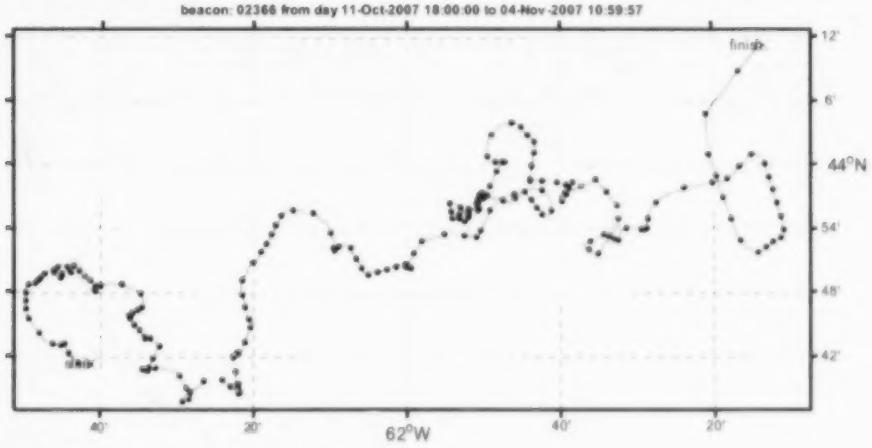

Figure 80 Drift track for drifter 02366

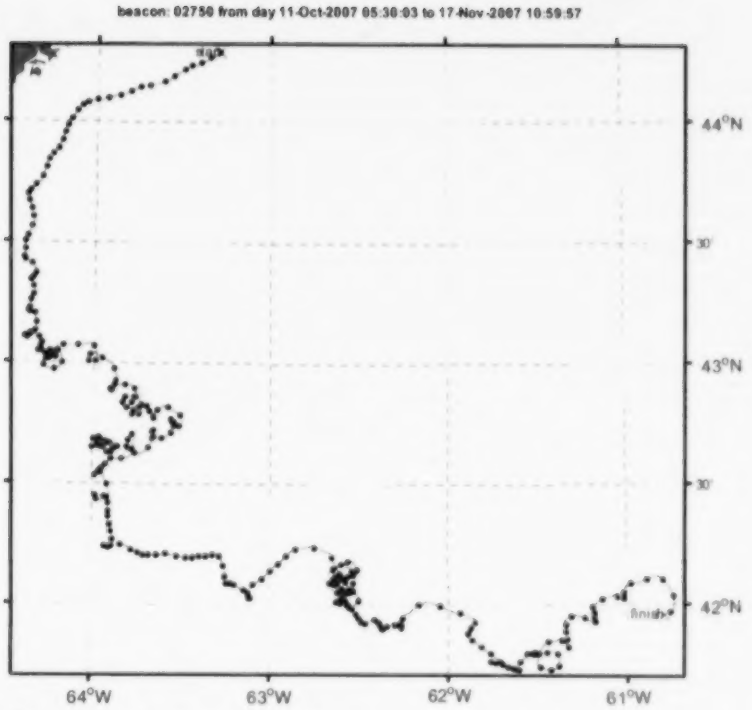

Figure 81 Drift track for drifter 02750

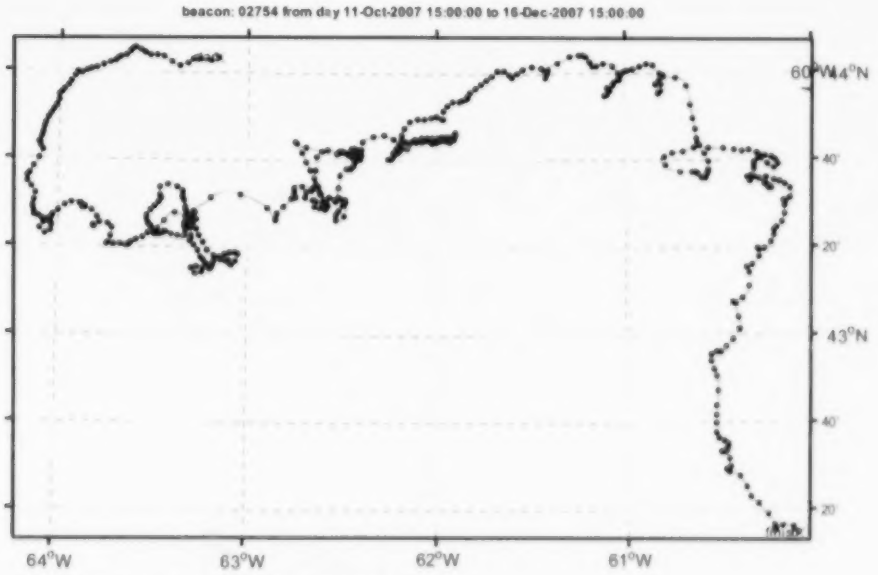

Figure 82 Drift track for drifter 02754

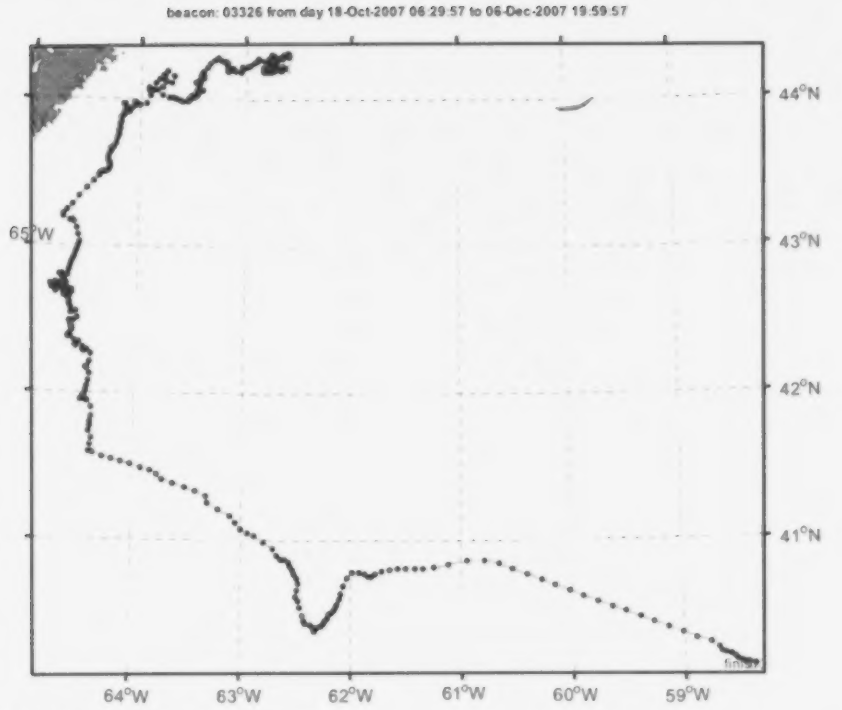

Figure 83 Drift track for drifter 03326

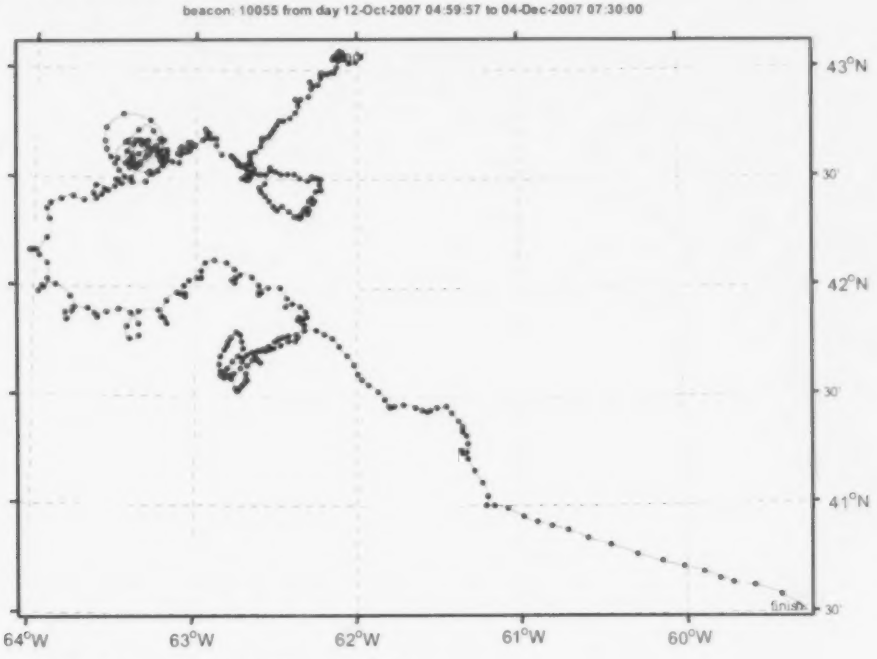

Figure 84 Drift track for drifter 10055

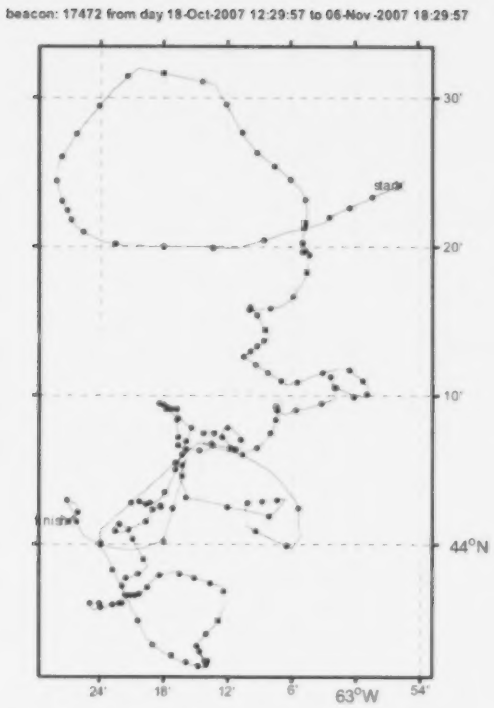

Figure 85 Drift track for drifter 17472

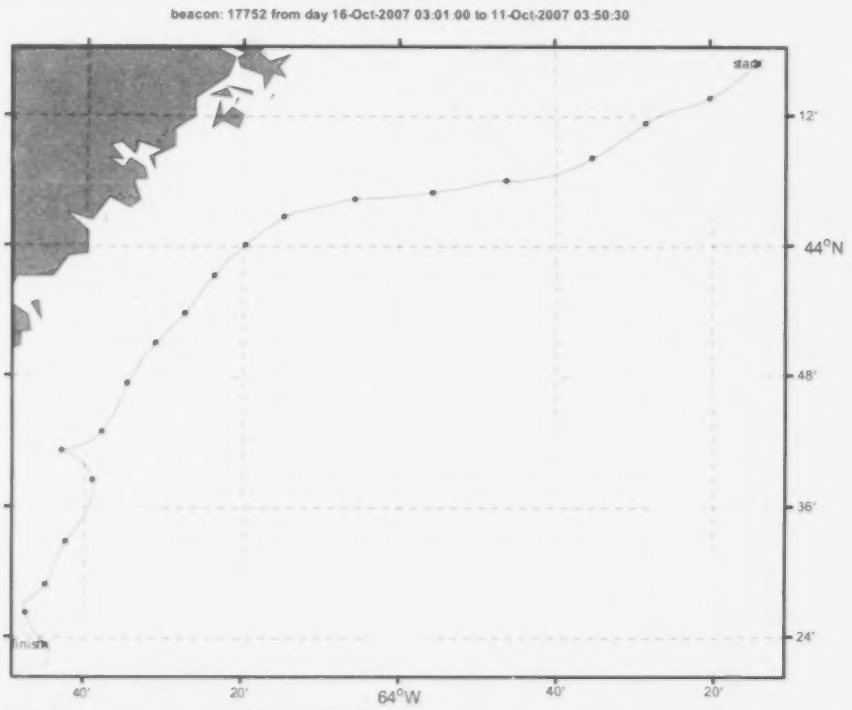

Figure 86 Drift track for drifter 17752

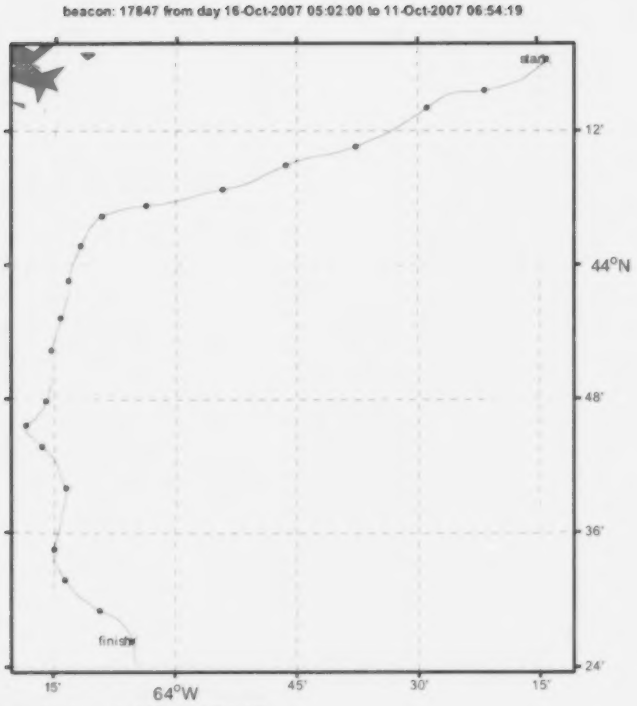

Figure 87 Drift track for drifter 17847

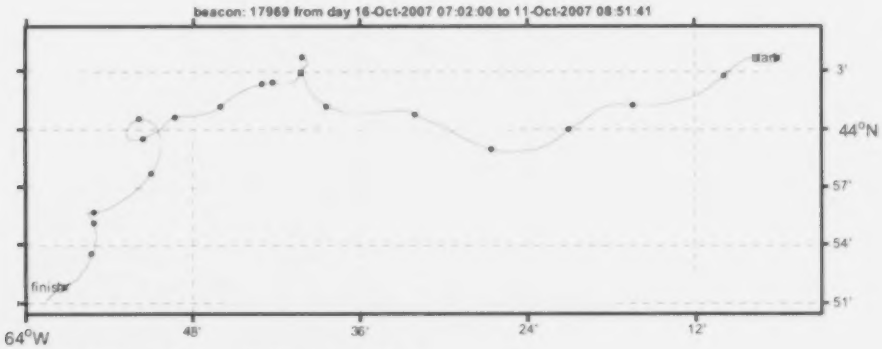

Figure 88 Drift track for drifter 17969

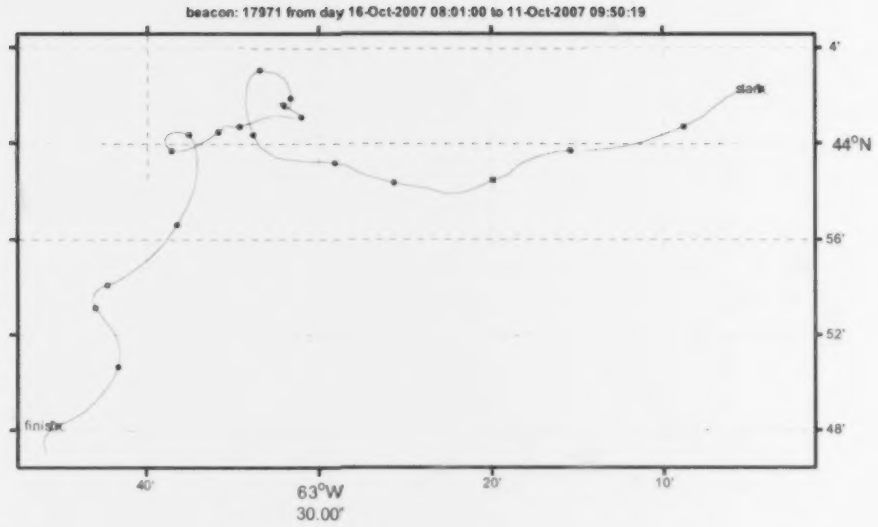

Figure 89 Drift track for drifter 17971

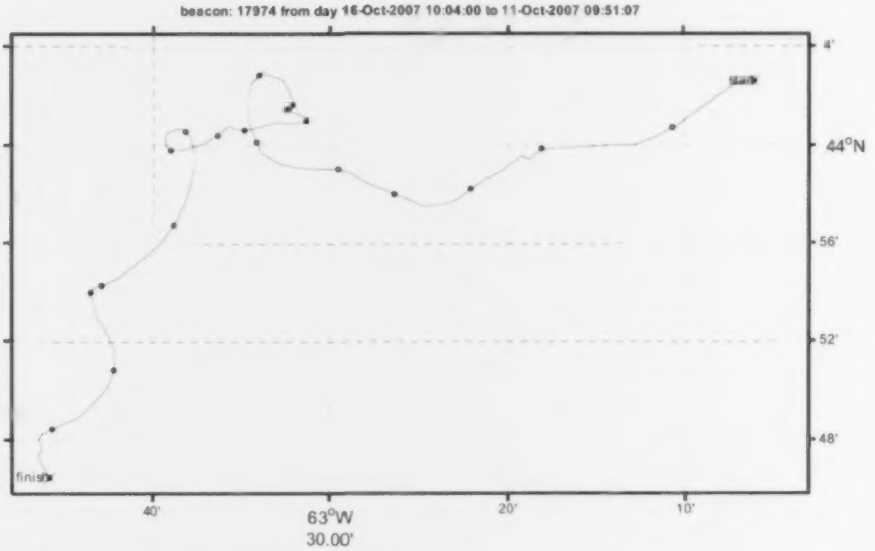

Figure 90 Drift track for drifter 17974

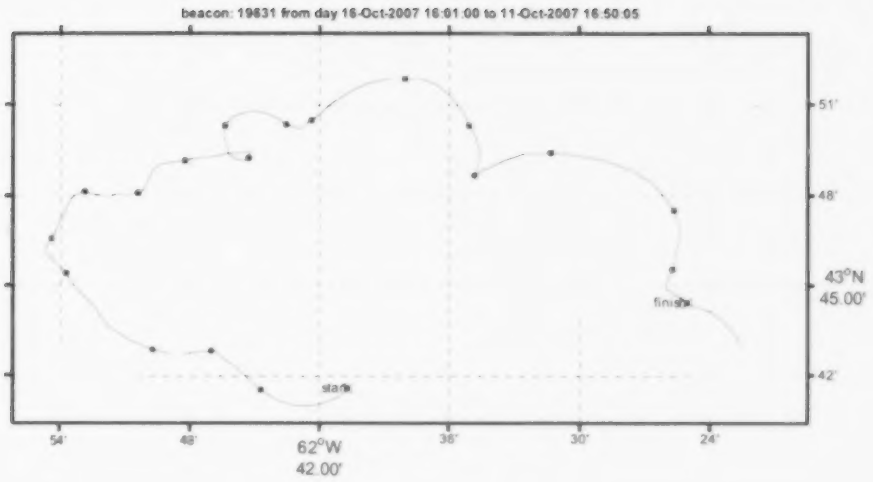

Figure 91 Drift track for drifter 19631

7 Appendix 2: Individual drifter drift tracks for 2008

Individual drifter tracks show the trace of the entire time series where each dot depicts every 6th point in the series (every 3rd hour for the MetOcean drifters and every 6th hour for the Seimac drifters).

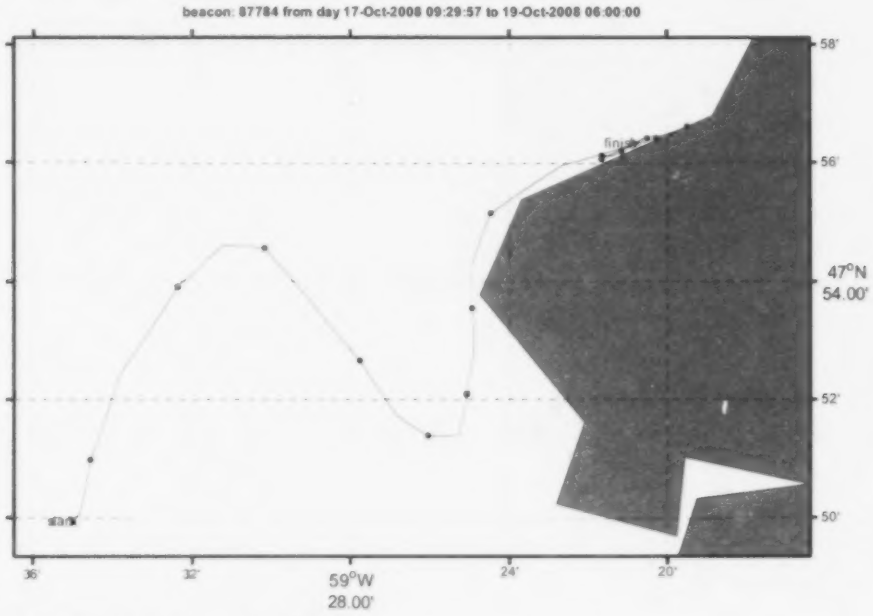

Figure 92 Drift track for drifter 87784

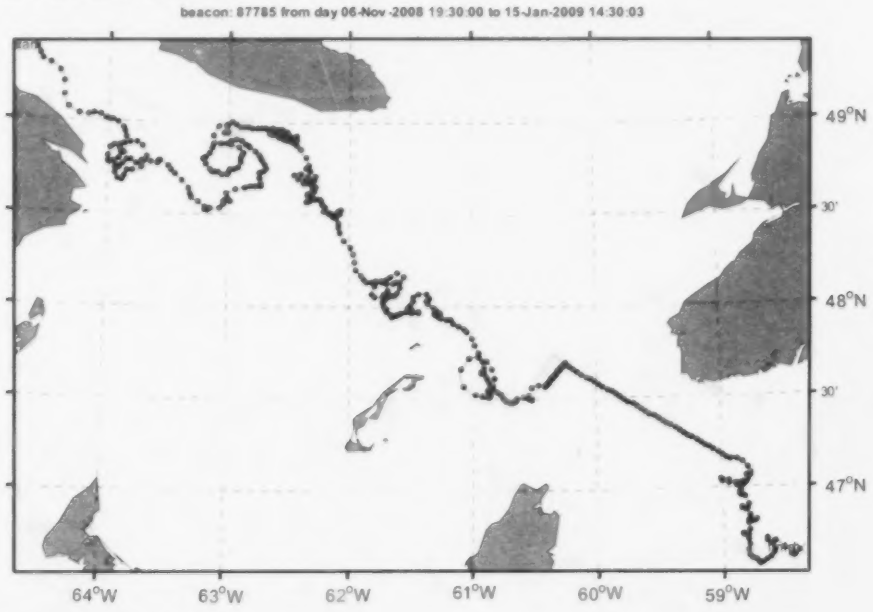

Figure 93 Drift track for drifter 87785

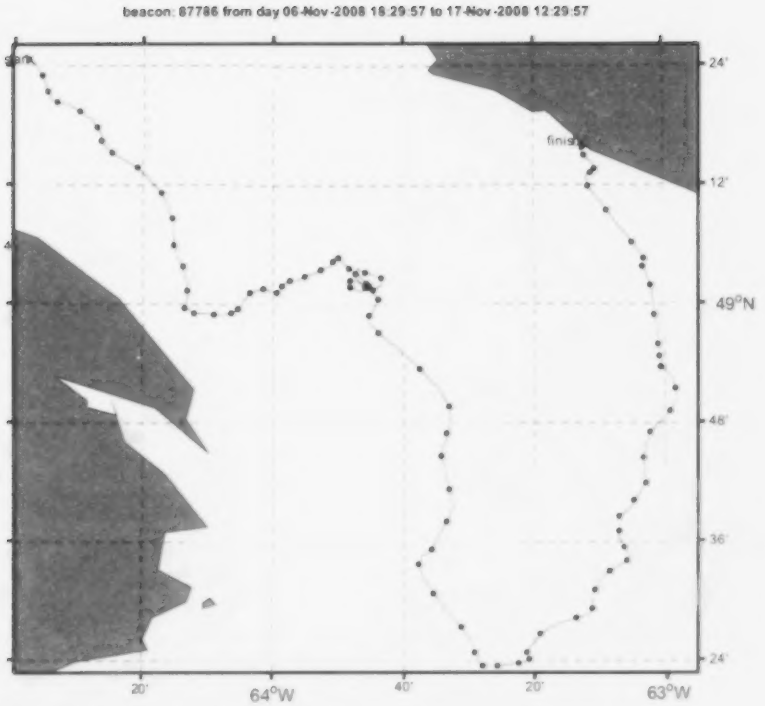

Figure 94 Drift track for drifter 87786

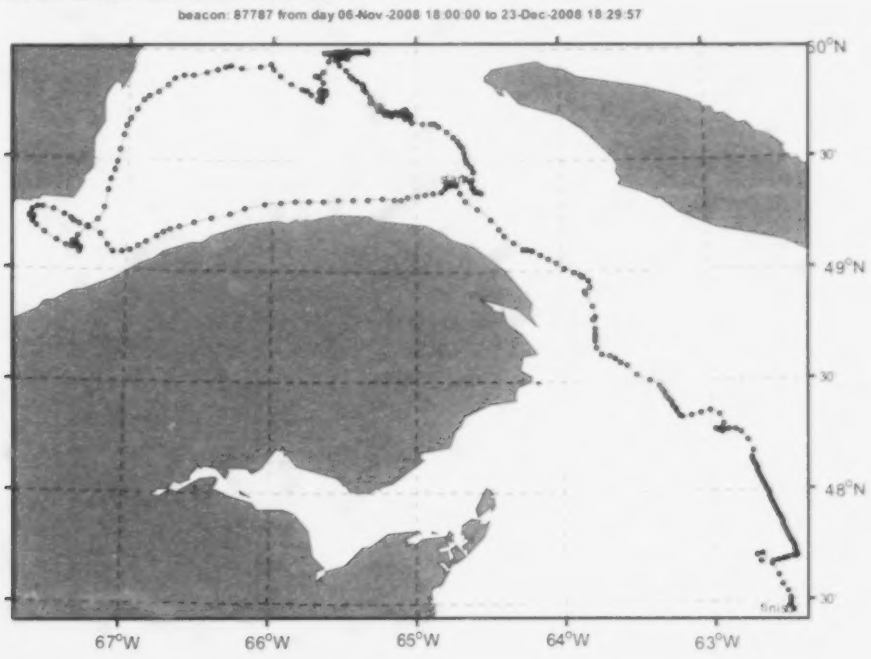

Figure 95 Drift track for drifter 87787

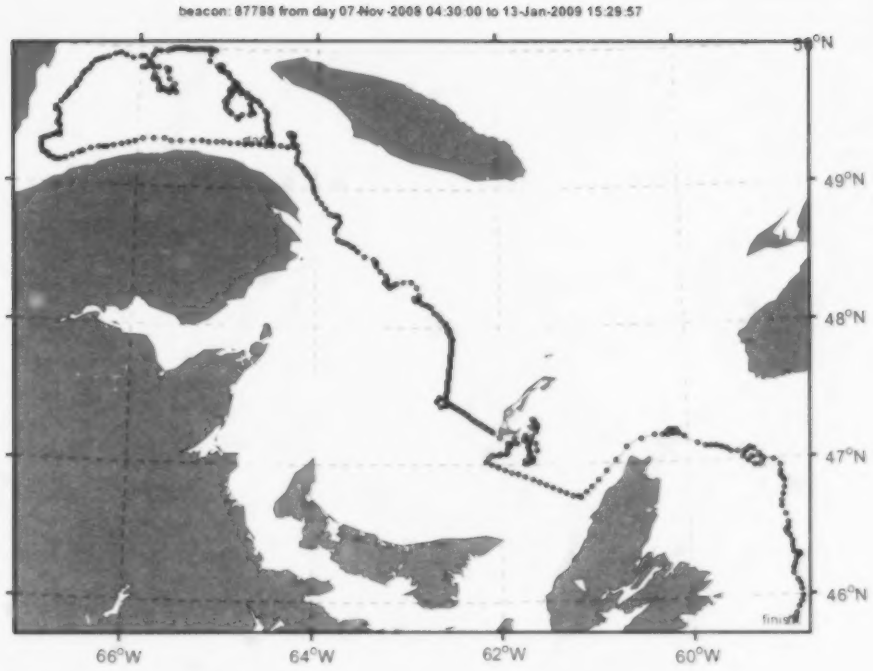

Figure 96 Drift track for drifter 87788

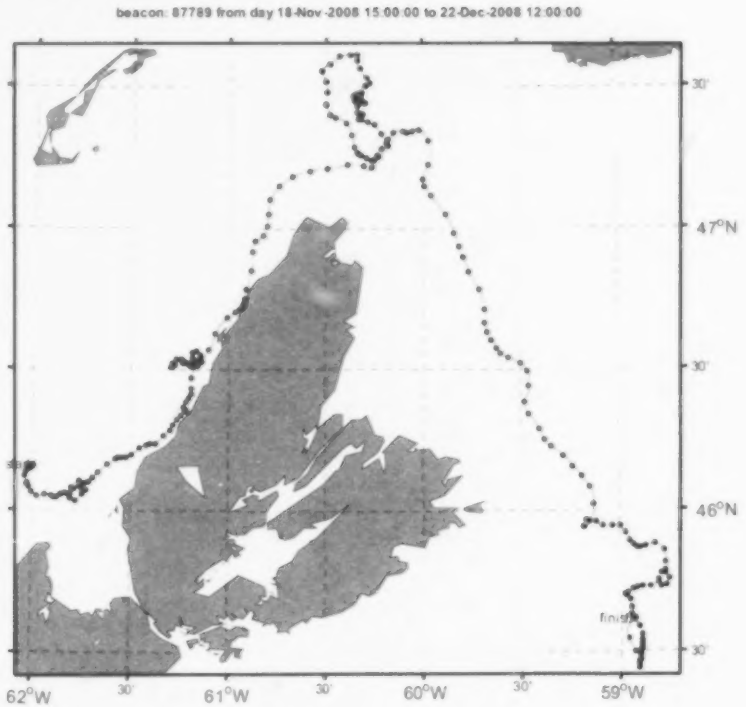

Figure 97 Drift track for drifter 87789

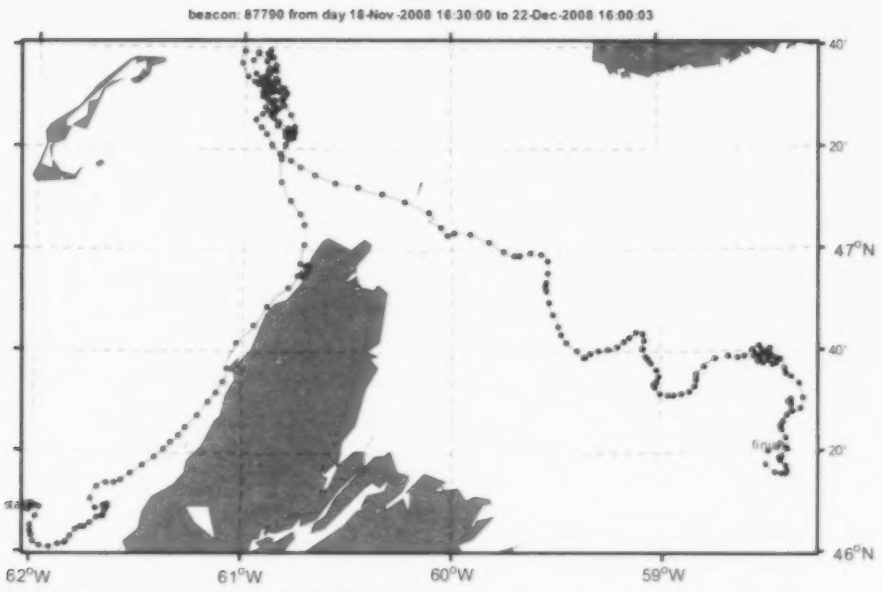

Figure 98 Drift track for drifter 87790

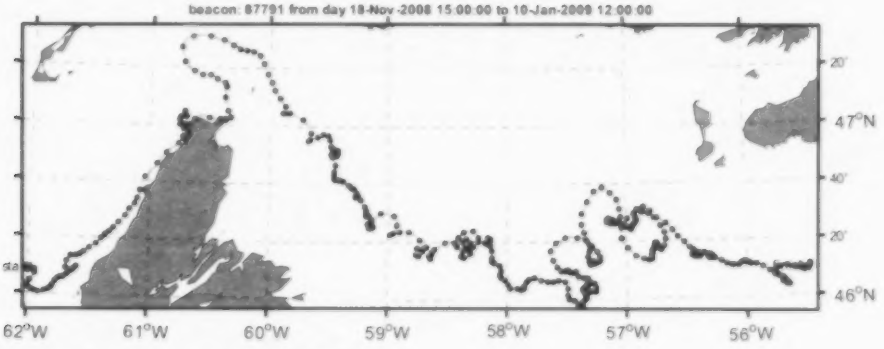

Figure 99 Drift track for drifter 87791

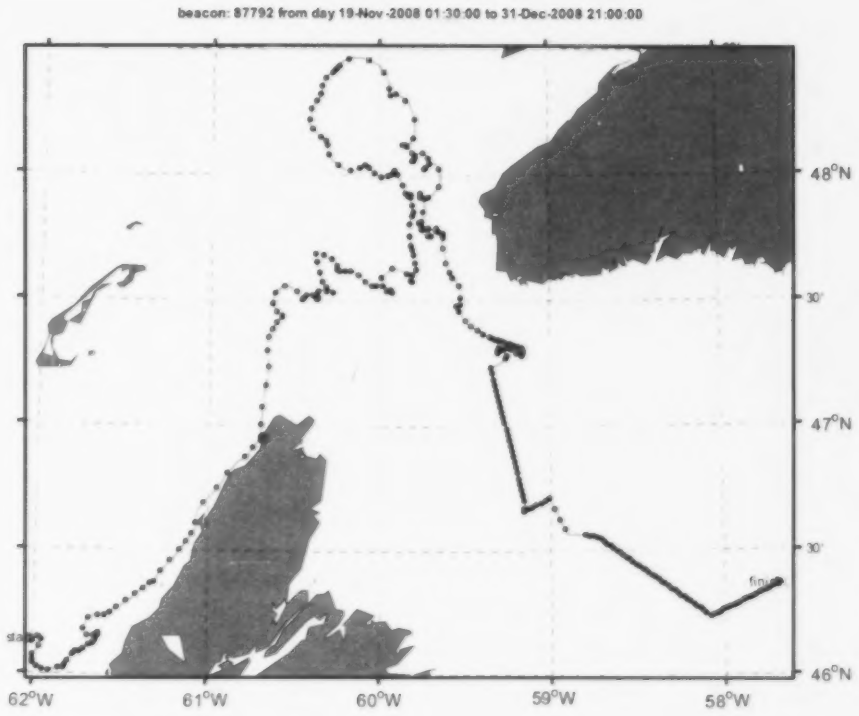

Figure 100 Drift track for drifter 87792

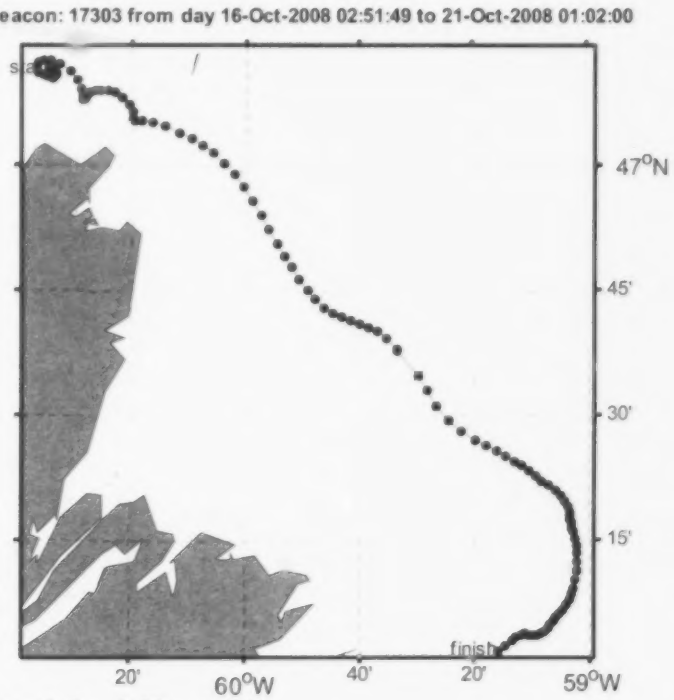

Figure 101 Drift track for drifter 17303

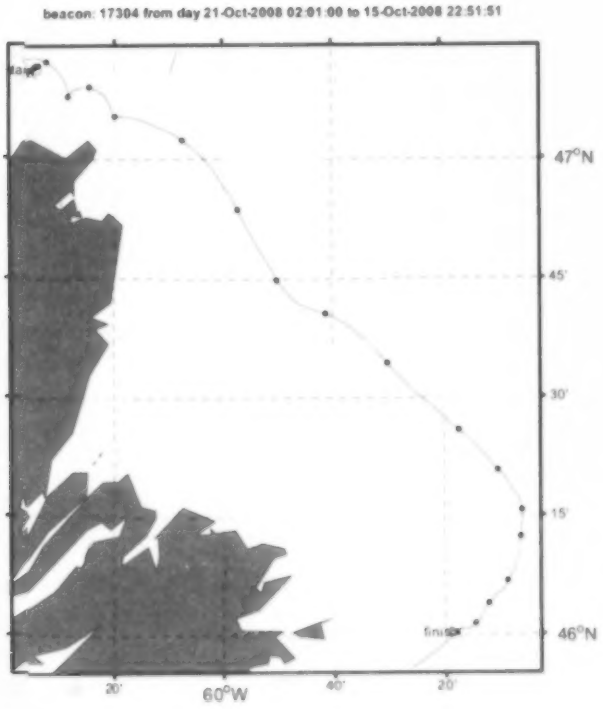

Figure 102 Drift track for drifter 17304

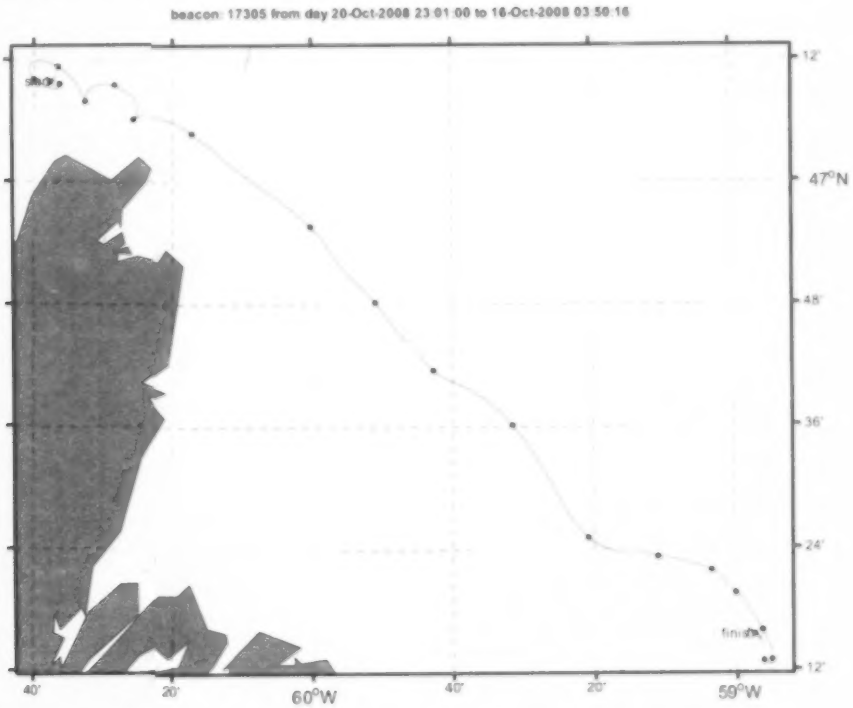

Figure 103 Drift track for drifter 17305

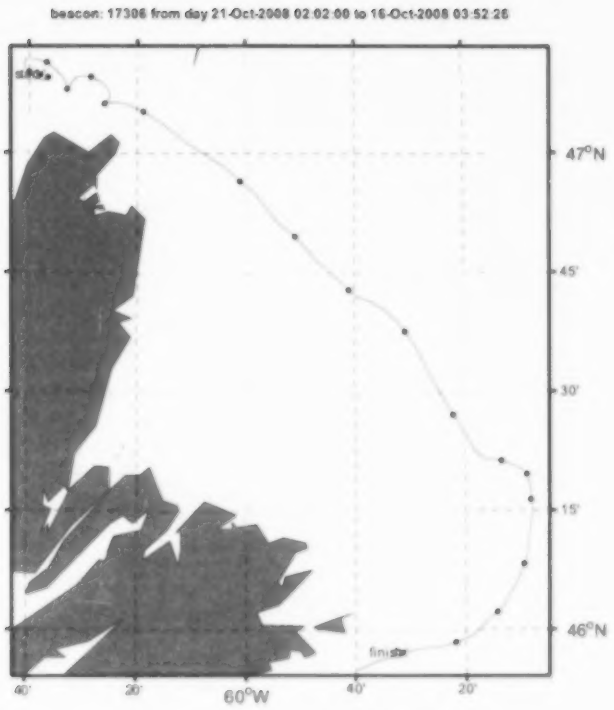

Figure 104 Drift track for drifter 17306

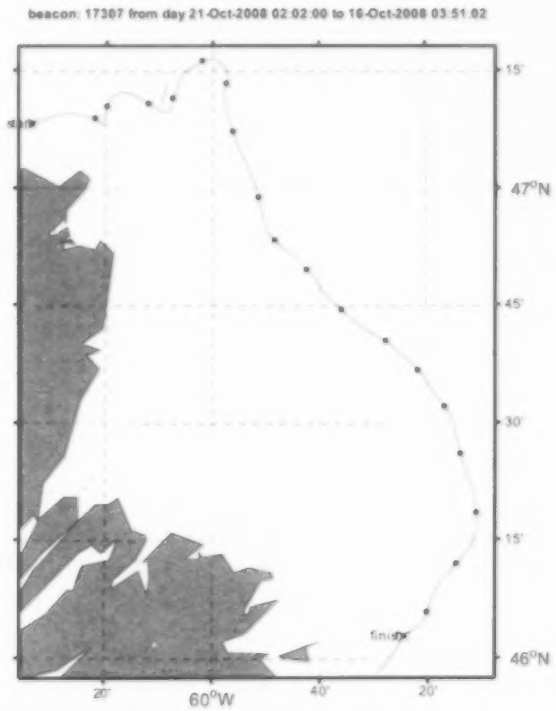

Figure 105 Drift track for drifter 17307

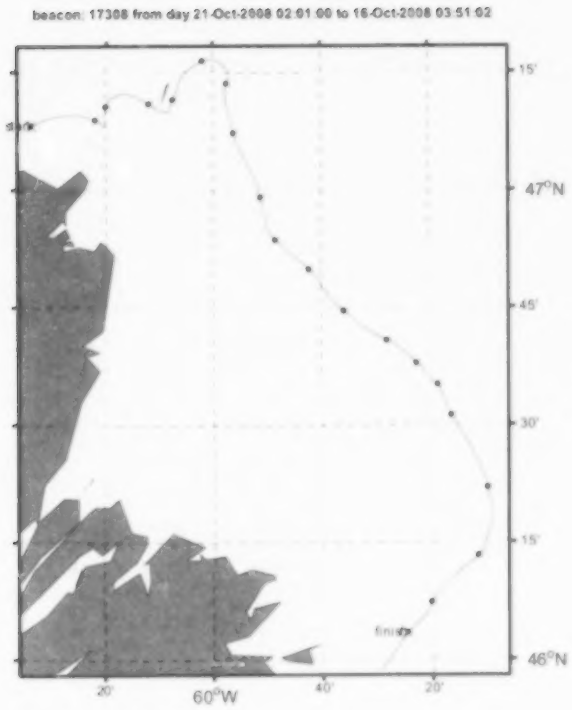

Figure 106 Drift track for drifter 17308

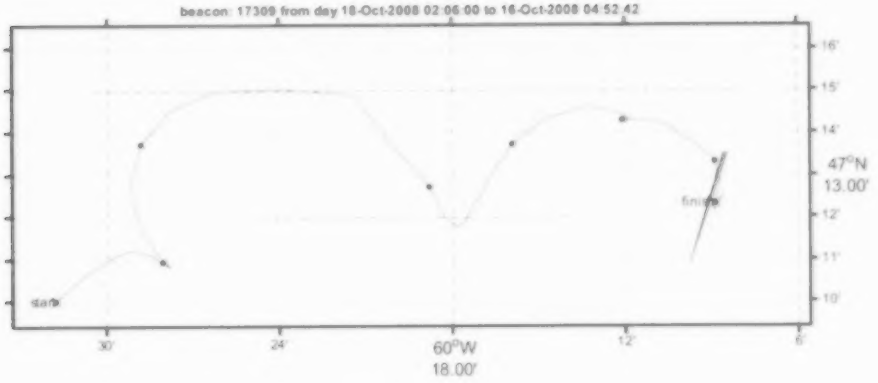

Figure 107 Drift track for drifter 17309

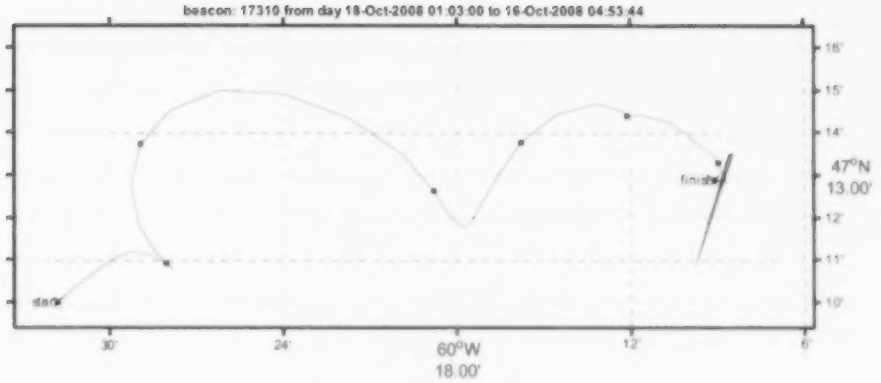

Figure 108 Drift track for drifter 17310

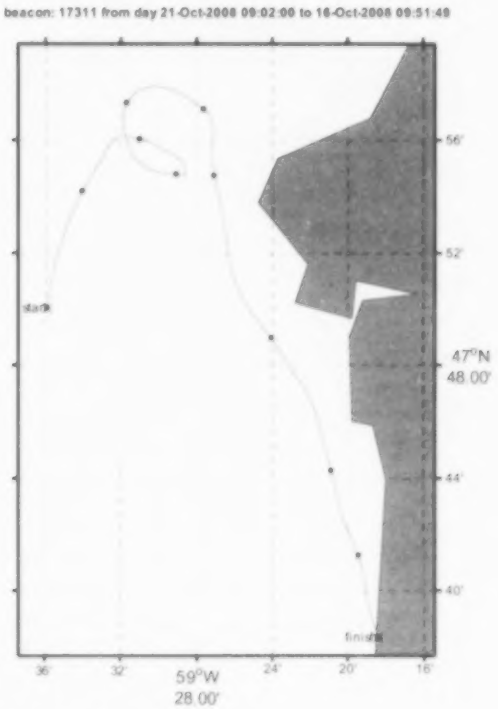

Figure 109 Drift track for drifter 17311

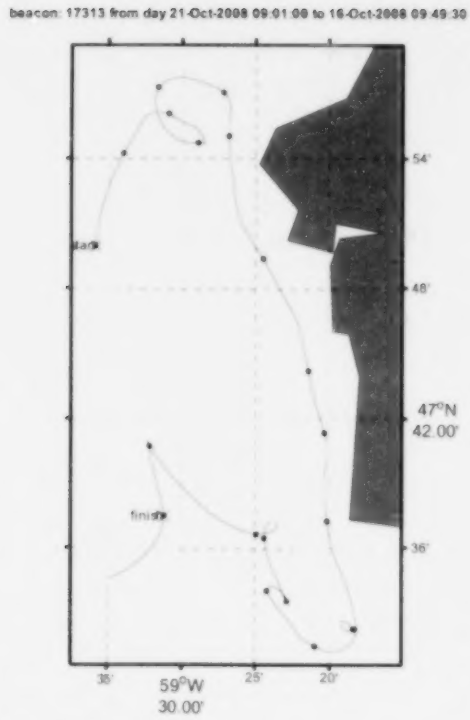

Figure 110 Drift track for drifter 17313

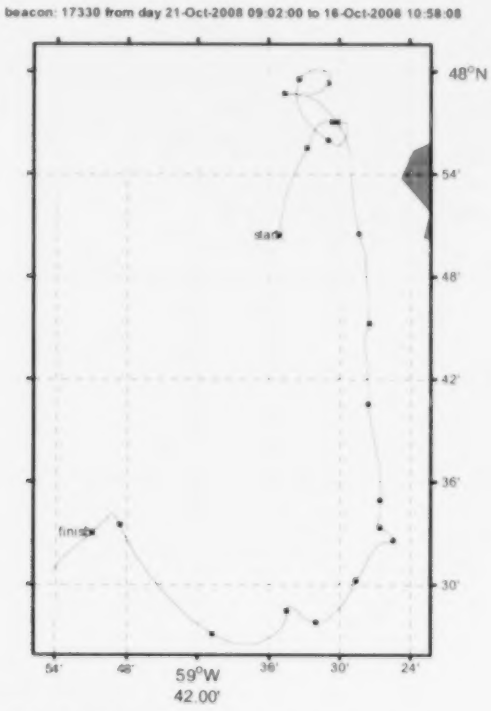

Figure 111 Drift track for drifter 17330

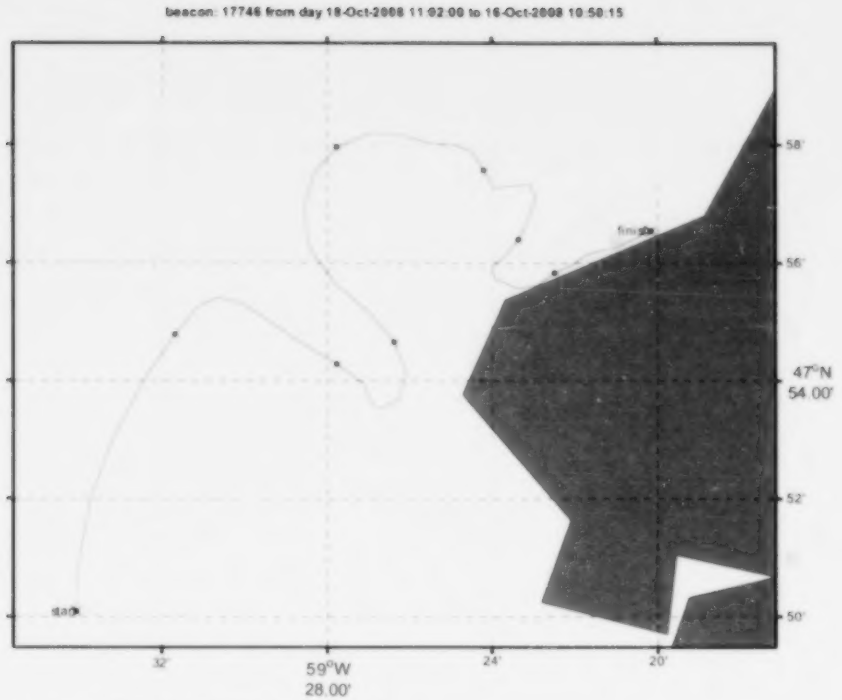

Figure 112 Drift track for drifter 17746

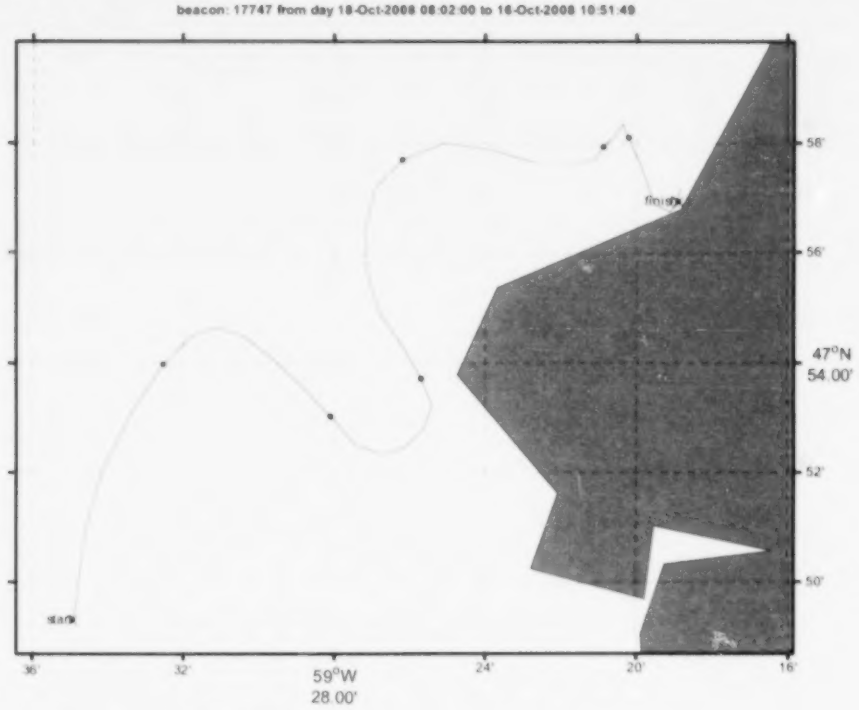

Figure 113 Drift track for drifter 17747

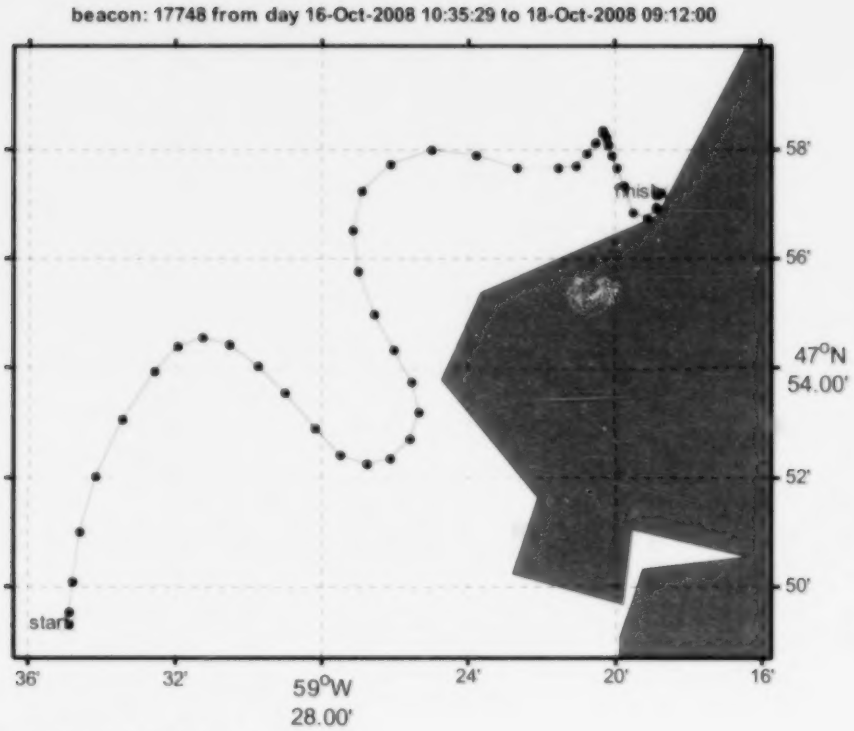

Figure 114 Drift track for drifter 17748